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October 30, 1924

River and Rail Freight Terminal at Memphis

Staff Report of the Fall Meeting of the American Society of Civil Engineers

Design and Plant Layout of Los Angeles Hosiery Mill

Building a Hydro-Electric Plant on the Saguenay River: 3

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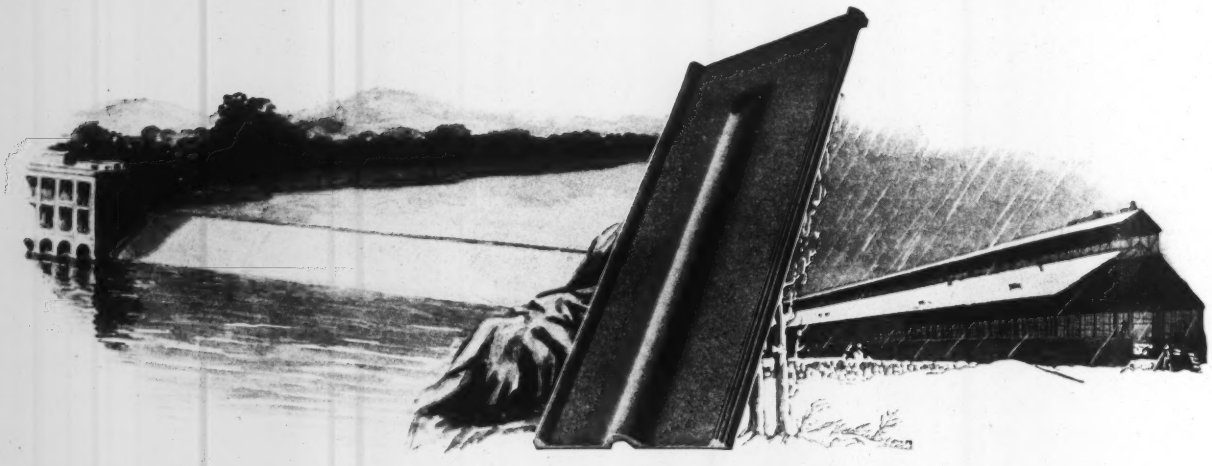

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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Young But Experienced

CLIFFORD M. HOLLAND was the perfect example of the specialist in engineering. To become the chief engineer of the greatest subaqueous tunnel project in the world at thirty-six requires exceptional ability and a dominating personality, but more than that it requires that the thirteen prior years be crowded with experience in the new work to be undertaken. The ability and personality Holland had, but in 1919 when he was chosen to build the Hudson vehicular tubes he had besides the most extended and intensive experience in subaqueous tunneling around New York City of any man of his time, of whatever age. He came to his new job young and eager but equipped as were few other men in the profession and he carried it along with characteristic energy and efficiency. That he should have to die the very day before the first tube was holed through adds a special touch of tragedy to his untimely passing.

Performance Curves

THERE are two interesting construction progress curves in the concluding article this week on the Saguenay River hydro-electric plant. They are interesting because in both structures, the crib cofferdam and the power house head wall, performance was consistent and consistent performance is the index of efficient management. It is seldom that the saw-tooth performance curve may be regarded with complacency although frequently it furnishes spectacular figures of output for a short period. The construction manager who swings his operation evenly into second gear and holds it there, is, as a general thing, counting up profits for his employer more certainly than is the one who runs first low and then high. This like all generalities has its exceptions. Often a burst of speed meets the requirements of quick earnings or of seasonal obstacles better than does a steady gait, but this is quite a different situation than is represented by the ordinary performance curve. Commonly in ordinary operation the erratic performance curve means that the manager is allowing ordinary shifting conditions to govern performance. If conditions favor high output it is recorded and if they present obstacles the manager allows them to hold him back instead of kicking the accelerator. Again a scrutiny of the performance curves previously mentioned is suggested. Interpreted in the light of the conditions described they have a very definite significance.

Lining Up for a Fight

THE efforts being made to secure the general adoption of laws requiring road traffic to come to a full stop at unprotected railway grade crossings have attracted repeated attention in the last year or two. It was charged by a speaker at the Detroit meeting of the American Society of Civil Engineers that there is a determined and organized railway propaganda for such laws. Highway men are almost universally opposed to a stop law. Probably few road users believe that the full stop at railroad crossings would reduce the chance of accidents; a great many believe quite the contrary—that the chance of accident would be greatly increased. If, then, organized propaganda in favor of such laws exists, it may be appropriate to have an organized movement in opposition to them. In the near future the fight between the two opposing views must be fought out.

Spread the Gospel

IT IS one of the most amazing things in the construction business that builders, both contractors and engineers, continue to defy natural law in placing concrete in freezing weather. There is no better verified fact than the lowered strength of concrete deposited below 50 deg. F. nor has there been any fact regarding construction which has had more publicity. Nevertheless year after year concrete continues to be deposited in freezing or near freezing weather with none of the precautions to make it safe or durable. Last winter a large hotel in Michigan and a stadium in Indiana were built with little if any regard for cold weather; the former collapsed, the latter gradually failed. Supposedly competent supervision existed in both cases. For these two major failures there are thousands of minor ones that never come to light, but which exist to offer proof of the instability of concrete. Because there are so many who are willing to disregard the warnings of cold weather work, for there can be few who have not heard them, it is necessary to keep hammering away at such warnings. Every engineer and contractor should now, in these days of dropping temperatures, take upon himself the burden of self warning and of propaganda. Concrete can be made safely in cold weather—but only with great care. Let everyone spread that gospel.

Engineer Heads Health Association

FOR the second time in its existence of over half a century the American Public Health Association has elected an engineer as president. Forty years of its history elapsed before the association bestowed its highest honor on an engineer, in the person of the late Rudolph Hering. Now after thirteen years more another engineer has been given a like honor. It is true that primarily Dr. Henry F. Vaughan owes his elevation to the presidency to his record as health commissioner of Detroit, but his education and his professional experience prior to his Detroit appointment were in engineering and he is a D.P.H. rather than an M.D. Although two engineer-presidents in over fifty years is scant recognition of the part that the engineering profession has taken in the advancement of public health, it is good as far as it goes. It will not

wholly eradicate the feeling that the A.P.H.A. is too much dominated by the medical profession but it will help. As time goes on, if the title of "doctor" be considered by a majority of the members as a prerequisite to appointment as health officer and to election as president of the A.P.H.A., it will be D.P.H. rather than M.D. that will count.

A Narrow View

BITTER disappointment must have been felt by the water engineer of Baltimore when his fellow engineers heading city departments disapproved his plan for including in the 1925 city budget appropriations to pay the water department for water supplied by it to other city departments. Mr. Siems' fellow engineers, constituting the Board of Public Improvements, "viewed the plan merely as one of unnecessary bookkeeping and one of 'robbing Peter to pay Paul'," states the Baltimore *News*. This is a surprisingly narrow view for engineers, who should appreciate the wastefulness and inefficiency in municipal affairs that result from not making each department financially responsible for all services rendered to it. Not to do so is particularly inexcusable as regards water, which is so readily measured and so likely to be wasted when it is supplied gratis.

Why Keep Records

A COMMITTEE of one of our national engineering societies is now studying the behavior of concrete, trying to establish the relations between the materials and methods of construction and the present condition of ten to fifteen year old structures. It is a most necessary and useful work but it is being hampered by the lack of proper information from which to determine the actual conditions under which the work was built. This lack is not only to be found in private work, where records are not kept so well or filed so long as in public work, but even on some of our largest and most prominent public enterprises. Tests of sand are not available, which is possibly not strange when we consider the laxity of sand specifications a decade ago, but worse than that in many cases there is no record of where the sand was obtained. Specifications requiring a 1:2:4 mix are to be had, but whether there was wet or dry concrete remains a matter of opposing personal recollections. Keeping records is a tedious job, but it is a most necessary one, unless the engineer considers his function complete when he finishes a structure. If he does so consider he forgets one of the most important things he has to do—that is to pass on to his future self and his successors the fruits of his experience.

An Inadequate Discussion

AFTER listening all day to the session of the American Society of Civil Engineers on the St. Lawrence project one has to conclude that an open engineering meeting is not the place to discuss a subject which, though essentially engineering, has diplomatic and international complications. Several Canadian engineers were scheduled to discuss the major paper but with the exception of one of them, who quite correctly, we believe, protested against some indiscreet statements in the main paper, the Canadians remained away. No one can, of course, say that this absence was dictated by governmental policy, but the diplomatic complications of the St. Lawrence case are becoming so acute that it would be a fair assumption that both Mr. Challies and Mr. Surveyer were governed by something other than their personal engagements in remaining away from Detroit. Further than that, outside of Mr. Shenehon's paper, which with the exceptions noted was an admirable technical exposition of a major engineering problem, and Professors Sadler's lively contribution on ship design, the discussion was inadequate. The advocates of Chicago's diversion, for instance, must have known that they were presenting only the merest outline of their case and were emphasizing, particularly in their impassioned pleas for the health of Chicago, those features which appeal only to the lay mind. The Chicago case is now being considered by a distinguished body of engineers, most of whom were at Detroit. They know how involved are the questions they have to report on and how superficial are any discussions which put forth potential typhoid as a complete defense of the drainage diversion. Neither the Chicago controversy nor the St. Lawrence development are going to be decided on sentimental or superficial grounds. The whole question is many sided, and unfortunately the discussion at Detroit, although a whole day was given to it, did little but touch on certain points and by no means the high points. Little if any illumination was given to what is one of our most serious public questions.

Taking Stock of the Technical Division

AT THE last six of the quarterly meetings of the American Society of Civil Engineers simultaneous sessions on from two to four different major engineering subjects have been held under the auspices of the newly created technical divisions. It is possible, therefore, to take stock now of the whole technical division idea and to consider early in its development how its future may be improved by a study of its past.

It has been obvious, for instance, that the recent meetings have taken on a technical flavor much missing in some of those which followed the war, a flavor which is one of the first necessities of a technical society. To that extent the technical division has been most successful. In the laying out of the program and the operation of the technical sessions, on the other hand, the experience has not been so happy.

In the first place, the mentors of each technical division have seemed to think it necessary that a meeting of each section be held at each quarterly meeting. This is overplaying the game. It is not possible that year in and year out members of these sections can meet every three months and profitably discuss the details of each specialty. With our highly inefficient method of conducting technical sessions, that is, with our apparent inability to minimize the read paper, the 90-day interval between meetings on any special branch of engineering is much too short. Meetings held thus frequently become tedious and perfunctory. This insistence, moreover, on having each section meet at each quarterly meeting results in a multiplication of sections at each regular meeting of the society, so that any member attending the general meeting has to choose during one day which of four or even five meetings he will attend. This is compartmentizing the civil engineering profession far beyond its need. At the recent Detroit meeting, for instance, practically every

man who was at the city planning session should have been at the same time in the highway session listening to the discussion on highway traffic, for certainly city planning experts must have some knowledge of that growing and serious subject.

Civil engineering is specialized enough as it is, and the engineering societies should not try to further confine a man's attention to one limited field. At the meeting of his society certainly he should have an opportunity to browse around at least into some of the allied fields outside of the particular specialty which he may be pursuing. This does not mean that there are should not be technical divisions, but it does mean that somewhat more judgment should be used in programming each division and that their meetings should be spread over wider intervals than they are now, so that there will not be too many meetings going on at each general meeting and that there will not be too short a time between the sessions of any particular division.

A Joint Responsibility

"TAX valuations are far too high," recently remarked the manager of an irrigation project. "The tax boards overlook the fact that little real value attaches to the land until it is brought to systematic production." These few words contain a serious charge of neglect or oversight against Western state administration. It is in the power of the state authorities to avoid or prevent the errors indicated. By their right or wrong handling of the tax problem, they can either stimulate or oppress the development of a newly reclaimed region. If they place tax values so high as to discount the future, a wet blanket of inflation and debt is spread over the energies of the settling farmers, and their chances for success are at once made very dubious. The high valuations lead to high taxes, and these in turn make the inflation burden less easy to bear and more certain to cause failure.

This entire sequence of results is to be expected from the irresponsible position of the state in reclamation development. When the state fails to take its proper share in the problems of development, its authorities see only the new opportunity for taxation, the new "values" created in their midst by the enterprise of others, and fail to realize the burdensome and often fatal effect of the taxes which they impose. The remarks of the project manager, in short, constitute a powerful argument for the view presented in these columns a few weeks ago under the head "Co-operative Reclamation." The state ought to share as financial partner in the responsibilities arising with reclamation development; if it does, it will readily perceive the scope of its obligation to foster the growth of the struggling new community. Failing to enter into such partnership, it has managed to impede rather than foster the growth.

The situation is clear, but up to the present it has wholly failed of recognition by the states of the West. There has been almost complete non-co-operation. One result of this mistake in policy has been to lock up great sums of national money unproductively, sums which if refunded by the farmers as they have agreed would have built other irrigation works. But whatever the loss to the nation, the states have surely been the greatest losers. They have held back the progress of their own settlers, their own towns and farming districts, chiefly to their own loss. The co-operative policy which a few weeks ago we advocated from the standpoint of the nation's interest promises the most gain to the reclamation states and the reclamation communities.

New Problems in Highways

THERE was a marked difference between the discussion of highway problems at the Detroit meeting of the American Society of Civil Engineers and previous highway discussions before the society. Design and construction, which have monopolized the stage for many years, were not mentioned, beyond a passing reference to the use of traffic-survey data as a guide to pavement design. The attention of the meeting was centered on traffic.

This is a right move. Traffic is so plainly the dominant highway problem of the day that this turning away from design and construction to the newer and greater difficulty is eminently proper. In fact, the change of front is perhaps a little belated. The traffic problem has been looming large for a number of years, and has been casting an ever-growing shadow like a storm cloud. It is now so big and threatening, and continues to grow so rapidly, as to leave no doubt that all possible attention should be centered upon it. Concentrated discussion of traffic study and congestion problems is therefore greatly to be welcomed; not only future meetings of the highway division but also meetings of the society, can well be devoted to the subject.

Capacity and safety are the two major aspects of the highway traffic problem. County roads and city streets are equally involved, for even in the vexatious matter of parking, traffic raises the same questions in the country as in the city. While safety is clearly entitled to first consideration, in view of the damning casualty record of motor traffic, probably capacity and safety go hand in hand in most instances. The two may sometimes diverge, however, as illustrated in the assertion of J. N. Mackall, of Maryland, that if a city like Detroit were to equip every street intersection with start-stop flashers the safety of traffic movement would be not much affected but the capacity of the street system would be very seriously decreased.

Apart from such special cases, we believe that as a working principle capacity and safety may be considered to be identical objectives. On this principle, anything that facilitates traffic movement and removes causes of congestion ought to be accepted as a safety measure. An illustration appears in the most remarkable item of the Detroit discussion, which was unqualified condemnation of speed-limit laws and a demand for the removal of all such restrictions as the present 30- and 35-mile limits, *in the interests of safety.* How seriously the speed-limit laws reduce road capacity has long been patent to everybody; and now they are denounced also as the prime enemies of safety. Similarly, slow-moving vehicles not only cause congestion, but also constitute road dangers.

However, all thinking on the highway traffic problem is still essentially impressionistic. There are very few quantitative data on which to base conclusions as to safety and capacity. Studies of road dangers and other factors of accident causation have only begun. Good work has been done by various highway departments in the last few years in finding out the defects of road planning and construction that contribute to accidents; but much more remains to be done. Collection and analysis of the facts is likely to prove a difficult and costly engineering task.

River-and-Rail Freight Terminal at Memphis, Tenn.

Car and Truck Inclines from Concrete Wharf-Boats to Buildings on Bluff—Tractors Haul Trailer Trucks in Warehouses

BY GEORGE W. FOSTER

Assistant Engineer with Walter F. Schulz, Consulting Engineer, Memphis, Tenn.

MODERN river traffic may be divided into three parts: (1) local business that has its origin in one river town and its destination in another town on the same river; (2) "warehousing in transit" business, or the handling of commodities that are consigned by river to a merchant or broker in a river town for distribution, or local products of farm or factory that are assembled at a river point for shipment; (3) the interchange business, or the transfer between rail and river of commodities in transit, such as the shipping of cotton from inland points in the Mississippi delta to Memphis for transfer to barge for export at New Orleans. A river terminal must be equipped to handle all three. It must have a freight house for the first, a warehouse adjacent to both river and rail for the second, and facilities for transferring freight between cars and barges for the third.

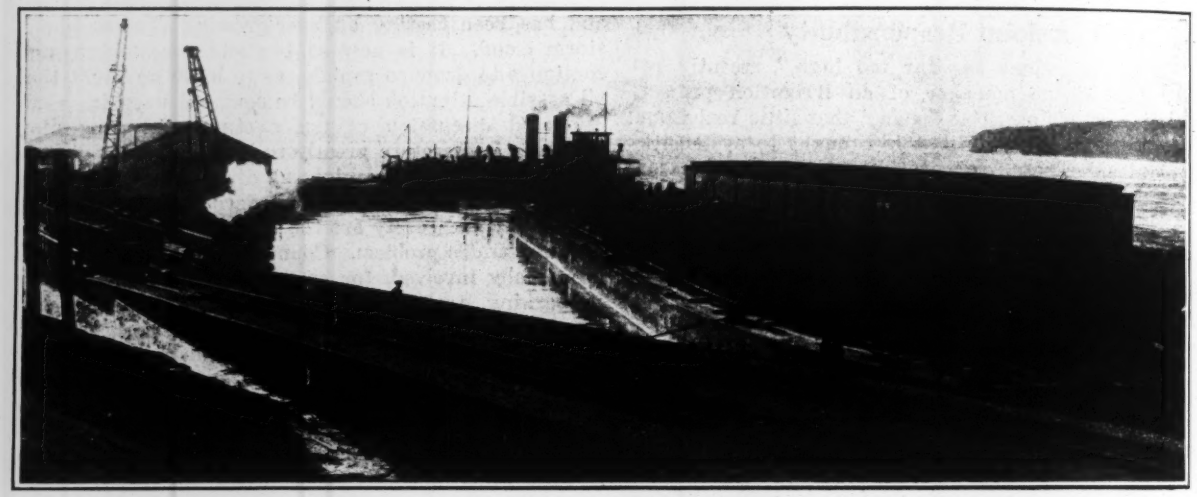


FIG. 1—MISSISSIPPI RIVER TERMINAL AT MEMPHIS, TENN.
Concrete wharf boat at left; cars standing on cradle connecting with incline. Tug boat handling barges.

In designing a river terminal for Memphis, two difficulties were the difference of about 100 ft. in level between the river and the railroads, and the annual variation of about 40 ft. in the stage of the river. The reasonable solution was to provide for the local and warehousing business by a floating terminal connected with buildings on the bluffs above, and to get trains down to the river level for the interchange business. Analysis of the operation and breakage costs eliminated consideration of handling freight between the high and low levels with derricks or cranes. Study of industrial installations of tractors and trailers led to the adoption of this method of handling for the local and warehouse business, the trucks loaded on the floating terminal from the barges being hauled up an incline to the buildings. For the interchange business, a standard-gage double-track railroad incline runs down the bluffs and out onto carfloats for direct transfer of freight. Connection with the eleven railroads radiating out of Memphis is established over a lead track extending east from the interchange yard. This interchange terminal is shown in Fig. 1, and a plan showing the arrangement of interchange terminal, local freight terminal and warehouses, with railway connections, is given in Fig. 2.

In the barge line service, six or eight barges of 2,000 tons capacity are handled by a single towboat, loaded barges being dropped and picked up on the way. The standard covered barge is 230x45 ft., with doors 24 ft. c. to c. on each side. For loading and unloading these barges it was decided to have a permanently moored floating transit shed or wharf-boat with doors on the outboard side matching the doors on the barges. A 50-ft width of shed was adopted for convenient operation of the trailer trucks. Three reinforced-concrete barges 265x37 ft. were available for this floating terminal, but it was necssary to build wooden false decks at the required height and to obtain the required width by supporting the columns and the overhanging floors on steel brackets tied together with truss rods above the deck and under the wooden floors. To provide for varying level of the barges hinged gangplanks are secured in each door opening and are equipped with self-contained screw-jacks.

Truck Incline—One of these wharf-boats is moored below the warehouses and in front of a double-track incline of 33 per cent grade to handle the trailer trucks, see Figs. 2 and 3. The upper portion of the incline is in a concrete tunnel through the clay bluffs. The lower end is on a pile trestle extending below low water. To permit operation at all stages of the river a cradle with horizontal deck travels on this trestle, the rail connections being made by feather rails. An electrically operated chain on the incline has dogs 20 ft. apart which engage lugs on the trucks and haul them to the top of the hill, where they are assembled in

trains and hauled to their destinations in the warehouse or freighthouses by electric tractors. An old cable incline, serving a wooden transit shed, is shown in Fig. 2, just above the new local terminal. This incline is a legacy from old steamboat days and is maintained in conditions for possible emergency use.

Four-wheeled rubber-tired trailer trucks are so arranged that a tractor can take a string of trucks around sharp corners and through narrow alleys. These trucks are about 2½x5 ft., with the platform only about a foot above the floor. The incline machinery is under the floor of the warehouse and the lower end of the chain goes around a 4-ft. pinion on the cradle. As the position of this cradle changes with the rise and fall of the river, chain links are taken out or added, as required. Two steel channels form a track for the trailers.

A gangplank between the cradle and the floating shed is suspended from overhead trusses on the shed and merely rests on the cradle and the barge, as a fixed or rigid connection might be disastrous with a 20,000-ton tow striking the shed while moving in at the rate of five or six miles an hour. The fenders and rubbing sticks on the outboard side of the sheds are so placed and braced as to develop a certain resiliency and the pine spar poles between the concrete hull and the shore are so placed that they will break under a blow sufficient to cause material damage if the floating equipment was not thus relieved.

A special feature at this incline is a rolling canopy that straddles the tracks and can be drawn up into the tunnel during high water or let down to the lower end in order to provide a continuous waterproof cover over the trucks during rainy weather.

Interchange or Transfer Terminal—At the lower or interchange terminal, two transit sheds of the design described are moored outside of two steel car floats that are moored in tandem in alignment with the standard-gage railroad incline of 3½ per cent grade from the top of the bluffs, Figs. 2 and 4. This alignment is maintained by lashing the fleet to a line of pile clusters along

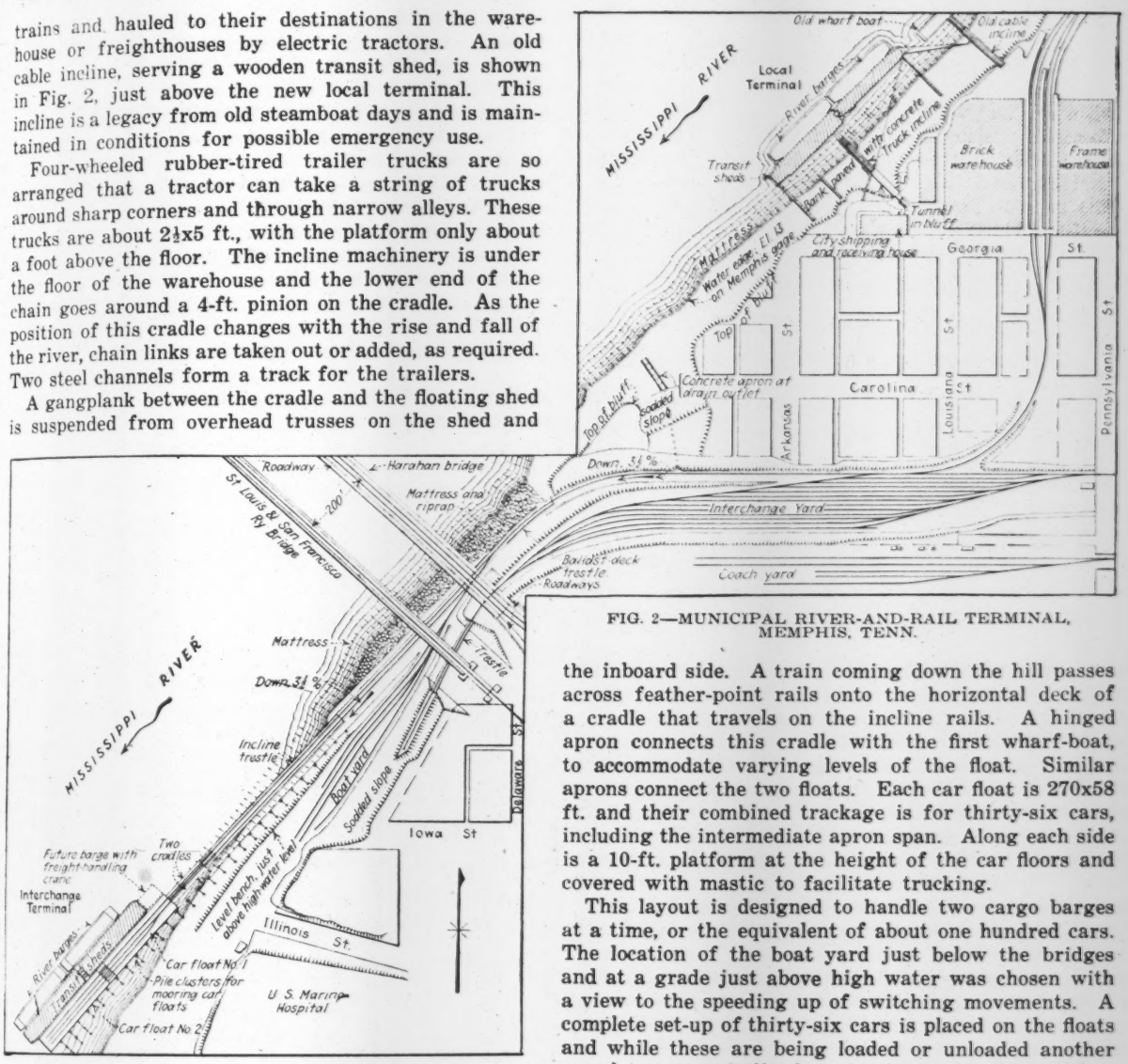


FIG. 2—MUNICIPAL RIVER-AND-RAIL TERMINAL, MEMPHIS, TENN.

the inboard side. A train coming down the hill passes across feather-point rails onto the horizontal deck of a cradle that travels on the incline rails. A hinged apron connects this cradle with the first wharf-boat, to accommodate varying levels of the float. Similar aprons connect the two floats. Each car float is 270x58 ft. and their combined trackage is for thirty-six cars, including the intermediate apron span. Along each side is a 10-ft. platform at the height of the car floors and covered with mastic to facilitate trucking.

This layout is designed to handle two cargo barges at a time, or the equivalent of about one hundred cars. The location of the boat yard just below the bridges and at a grade just above high water was chosen with a view to the speeding up of switching movements. A complete set-up of thirty-six cars is placed on the floats and while these are being loaded or unloaded another complete set-up is lined up in the boat yard, so as to minimize the time of making the change. A proposed barge with revolving crane for handling heavy loads is shown on the plan.

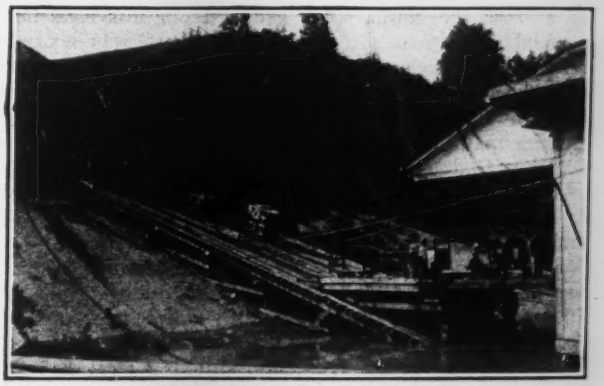


FIG. 3—ENDLESS-CHAIN INCLINE FOR FREIGHT TRUCKS
Wharf-boat and connecting cradle at right. Tunnel through bluff at left, with traveling canopy to cover incline in wet weather.

Construction Work—In view of the powerful current of the river in flood, careful attention had to be given to the protection of the terminals. The local formation is generally a dense yellow clay that will stand any load when dry and will not stand at all when water-logged. To complicate matters, at the immediate location of the terminals there is a loose sand stratum at about the level of low water. If not confined in some manner this sand will wash out during a falling river and a section of bluff ranging from the size of a box car to that of a city block may fall off into the river. The steps taken to overcome this condition were: (1) To slope the banks from top to toe; (2) to seal the sand stratum with brush mattress and rock; (3) to pave the slope with rock from below low water to above high water; (4) to sod the balance of the slope with Bermuda grass; and (5) to intercept all surface drainage at the top of the slopes and divert it into pipe or into concrete gutters.

On the incline tracks below the bridges there was a different situation. The original clay bluff had been washed away to about 10 ft. below the desired grade. A wall of dry rubble masonry was built along the river face of the tracks and a thoroughly rammed fill was placed behind it for a distance of about 300 ft. below the Frisco Ry. Bridge. From this point down to low water a ballast-deck creosoted pine trestle was built, followed by a green timber open-deck trestle long enough to carry the cradle at extreme low water.

The ballast deck trestle was built with a land driver without much difficulty, but the piling for the underwater portion was troublesome. Its site had been a public landing in earlier days, reached by a graveled road from the bluffs. The gravel from this road had washed down year after year until there was a crust several feet thick, while there were several old sunken steamboats, so that it was almost impossible to drive the piles in line. Pulling them over into line after driving made more trouble by putting the piles in such a strain that a submarine cutoff saw was stuck more of the time than it was functioning. The open deck was assembled and framed afloat and then sunk and anchored in position without much trouble.

Freight house and Warehouse—The building at the top of the bluff include a one-story frame warehouse 150x400 ft. and a one-story brick warehouse 230x380 ft., together with a smaller warehouse and also a freight house for receiving and shipping local freight. Two pairs of tracks passing between the warehouses are separated by a covered island platform 16 ft. wide and have side platforms between the tracks and buildings. At the north end these tracks converge into a lead connecting with several railroads. From the south end, a track connects with the incline and with a 12-track interchange yard forming part of the terminal and connected with other railroads. The boat yard, opening from the incline and just above high-water level, has four tracks.

This river and rail terminal was designed by Walter F. Schulz, consulting engineer and architect, Memphis, Tenn., and the writer was intimately connected with both the design and construction. It was completed early in 1924 and has sustained flood stages without injury. The terminal is owned by the city of Memphis, and is operated by the Federal Barge Line.

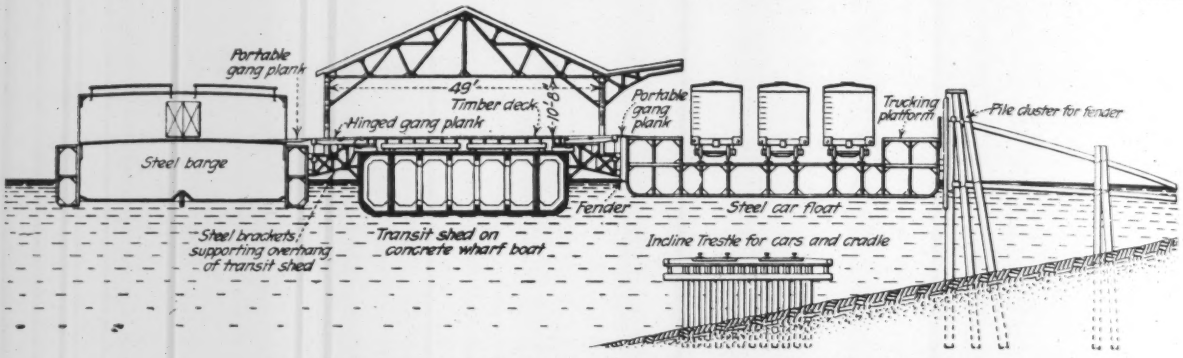


FIG. 4—FREIGHT TRANSFER BETWEEN CARS AND RIVER BARGES

For the Engineer in Public Life

An editorial in the St. Louis "Star" entitled "The Ego of the Lawyer."

IN SUPPORTING the Missouri Bar Association's campaign to raise educational qualifications for the legal profession, Attorney General Barrett, in an address at Cape Girardeau, said, "The problems of government are largely for lawyers to solve."

There is no doubt that the law is one of the great professions, and that the educational standard for practice should be raised just as it should be for all other professions. But there is considerable assumption in the statement that the science of government will rise or fall as the lawyers are ready to meet its problems.

If lawyers *per se* are such great administrators of government, it is strange, with the large number always in the Senate and House at Washington, in the two Houses of the State Legislature, and in executive positions, that they have not done a better job of it. Our complaint of government is that the legislatures and administrative offices, which are filled so largely by lawyers, are not responsive to public will.

Lawyers are the cause of much of our present complication of laws and bad government. They have encumbered the statutes of all states and countries with legal technicalities and verbiage that even they can not understand. While some lawyers have urged simplification and the use of understandable English in documents and laws the lawyer in the main has prevented throwing out of the complicated system of legal construction.

In recent years, as the engineer has come into public office, there has been a tendency to more exact administration. The lawyer's training is one of contention; he looks for something different, or to see wherein one case varies from another; consequently, in analyzing a problem, he looks for the multitude of small parts without welding them into a concrete mass. The engineer's training is one of construction. When he erects a building or a bridge, he knows it must be put together piece by piece, and that it is useless until finished. So, if one profession trains to the needs of government better than another—it will be done by the men whose training leads to a composite end, the engineer.

Ohio and Pennsylvania Test Roads Emphasize Subgrade

SUBGRADE soils and sub-base materials are the subjects of study on test roads in Pennsylvania and Ohio. The Pennsylvania test is in progress and arrangements are completed for construction in Ohio. In both states the Bureau of Public Roads engineers are co-operating. As examples of the form that test roads which will be built in the future are likely to take instead of being elaborate structures like the Bates and the Pittsburgh test roads, these short Pennsylvania and Ohio structures deserve attention.

Ohio Test Road—Two differences are shown from all other test roads by the 2,500-ft. project planned by the Department of Highways and Public Works of Ohio: (1) Imported sub-base material is employed throughout and (2) All the road is on grade, 0.6 per cent for 600 ft., 2.68 per cent for 1,200 ft., 5.2 per cent for 600 ft., and 6 per cent for 400 ft. The sub-base materials to be tested are grade A gravel, grade A sand, cement-clay and granulated slag. These materials are put in as sub-base alternately in lengths of 100 ft. and 200 ft., and 6 in., 4 in., and 2 in. deep. Various hard-surface pavements will be laid on the sub-base and the strength and other qualities determined.

Pennsylvania Test Road—About 2,000 ft. of nearly level concrete road have been built for the Pennsylvania tests. The purposes of the test are as follows:

1. To determine the action of a concrete pavement with a 5-in. center thickness and 8-in. edge thickness (8-5-8 section) under a 26,000-lb. gross load.
2. To determine the influence of subgrade material on the strength of the pavement.
3. To obtain further data on balancing the cross-section design.
4. To determine the effectiveness of the tongue-and-groove type of longitudinal joint.

Six different types of subgrades were prepared: Old macadam road scarified and rerolled, sandy loam, shale, clay, clay overlaid with 4 in. of sand-clay mixture and clay overlaid with 4 in. of cinder-clay mixture.

Concrete construction was carried out in the usual manner, and at approximately the center of each subgrade section a transverse expansion joint was provided. Adjacent to this expansion joint and on one side of the longitudinal joint over a length of 20 ft., inserts were placed in the slab in such a manner that strain gage readings may subsequently be obtained both for the top and bottom of the slab.

Control specimens, consisting of beams and cylinders, representative of the particular portion of the pavement in which the strain gages are to be installed were made. These specimens are to be tested and broken at the ages of 15 days, 28 days, 6 months, and one year, for the determination of the modulus of elasticity, the modulus of rupture and the compressive strength of the concrete.

The pavement is being subjected to heavy truck loads up to 26,000 lb. gross. Stress readings will be obtained with the truck run near the edge and at the center of the road. The truck will be run during the summer and during the time of the spring thaw. Field determinations of subgrade moisture and bearing value of the soil will be made on the days stress readings are obtained.

It is hoped the tests will answer these questions:

1. Is an 8-5-8 section adequate for occasional 26,000-lb. traffic?
2. What influence has the subgrade on the strength of the slab?
3. Will a 4-in. layer of good material improve the strength of a concrete road when laid on a poor subgrade material?
4. Is an 8-5-8 section a balanced design or should the center and edge thicknesses be adjusted?
5. How much of the load does the tongue-and-groove type of longitudinal joint transmit from one side of the slab to the other?
6. If an 8-5-8 section is not safe under a 26,000-lb. load, what is the safe load under spring conditions and under ordinary conditions?

Loading on Old Highway Bridge Reduced by Narrowing Roadway

AN OLD HIGHWAY bridge near Jonestown, Pa., that is too weak to carry modern traffic loads safely, has been narrowed by roadway fences to restrict the traffic to a single line in order to reduce the possibility of excessive loading on the structure. The adjoining view shows the fence arrangement. A joist and plank floor wide enough for the single line of traffic

SINGLE-LINE FENCED ROADWAY ON OLD BRIDGE

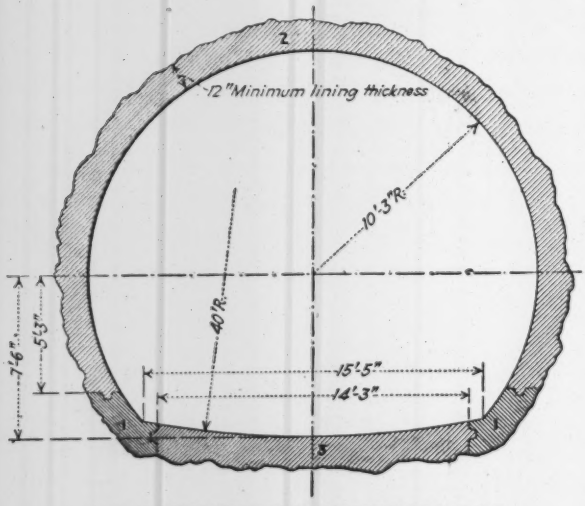
is laid across the deck of the bridge, midway between the trusses, and substantial braced fence posts with top rail and heavy hubguard plank are attached to the joists.

This bridge is one of several structures of antiquated bowstring type illustrated in *Engineering News-Record* of Oct. 2, p. 549. It consists of two spans of 111½ ft. each, with roadway 20 ft. wide. It is subject to dense and heavy traffic, and often heavily-loaded trucks passed on the bridge. It was condemned several years ago, and the county commissioners then petitioned the Grand Jury and Court of Quarter Sessions to replace the bridge with a reinforced-concrete bridge. The Grand Jury inspected the bridge, but, on seeing that trucks crossed it without breaking the structure down, pronounced it safe for traffic and refused the petition, recommending that additional piers be placed under the bridge and other repairs made that might be found necessary. The commissioners then put on the narrow fenced floor, reducing the roadway width to 10 ft. in order to avoid the possibility of heavy trucks passing.

Concrete Lining Methods in the Skagit Tunnel

Air Gun Built on the Job Places 300 Cu.Yd. of Concrete in 24 Hours—Traveler for Trimming and Setting Forms

A TUNNEL which was recently driven for the Gorge Creek plant of the Skagit project, Seattle's municipal power development, is 20 ft. in diameter and about 12,000 ft. long. Although driven through solid granite, it was believed best to line the tunnel with concrete as it will be under a maximum head of about



CROSS-SECTION SHOWING SEQUENCE IN LINING OPERATIONS

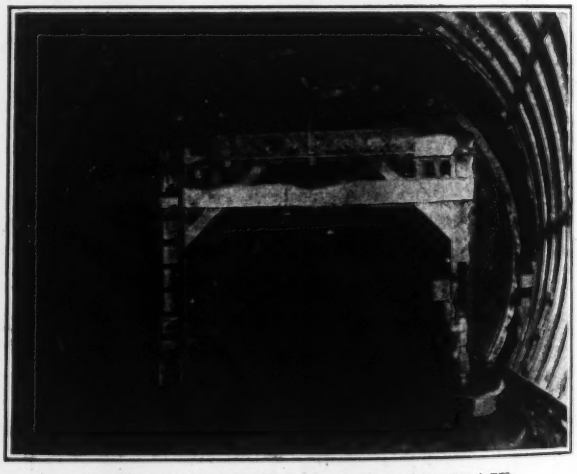
350 ft. The lining required some 60,000 cu.yd. of concrete and special attention was given to finding a means of placing it which would afford the greatest progress consistent with good concrete and a substantial job.

After some experiment a device was designed by R. C. Hackley, construction superintendent for the contractor, which fully met the requirements and was used in the concreting plants at both ends of the tunnel. In fact this device, or "concrete gun," proved so successful that the capacity of two four-sack mixers at the portal was found to be the limiting factor in lining progress and if the real capacity of the gun had been known in advance, a mixing plant of much larger capacity would have been installed. The "concrete gun" was operated by air pressure and had several features representing new departures in equipment of this type. These features can be described in detail as soon as patent negotiations are completed. For the present it will suffice to say that the new "gun" delivered concrete in 3-cu.yd. batches at a rate such that a 50-ft. section of the tunnel forms containing 250 to 300 cu.yd. of concrete could be filled in 24 hours. Concrete was mixed outside the tunnel and hauled in to the concrete gun which was mounted on a traveler or "jumbo" so it could be moved ahead as the work advanced.

Concreting operations were carried on in three stages, pouring being done first in the footings, then in the arch and finally in the invert. In general the method was as follows: Behind the steam shovel, which loaded muck at the headings, the carpenters set a 6x8-in. timber sill on either side of the tunnel to exact line and grade, and 7 ft. out from the center line. Forty-pound rails were then spiked to these timbers to carry the trim "jumbo" or traveler. This "jumbo" was the advance guard for the lining equipment and had air drills mounted on its frame to trim off any points of rock that were passed by in the main excavation. The "jumbo" also carried on its frame a templet cut to the exact cross-section of the finished tunnel and used to test clearances; any point of rock within 12 in. of this templet was trimmed off.

After the trim "jumbo" had passed, the rock was thoroughly washed with water under pressure and the steel footing forms set on the timbers. These forms were in sections 10 ft. long and about 2 ft. wide, and as a rule 100 ft. was set up at a time. At intervals of 2½ ft. anchor bolts were inserted through these forms in holes provided for that purpose. When the footing concrete had been poured and forms removed these bolts remained projecting out from the concrete about 6 in. and were used to hold the arch forms placed later. The footings were provided with keyways such that a good bond would be made with both the arch and invert concrete when these latter pours were made.

From the mixer at the portal concrete was brought into the tunnel in 3-cu.yd. cars hauled by gasoline locomotives on a track of 3-ft. gage. Gasoline locomotives were selected in preference to the storage battery type on account of the greater speed which was considered essential to avoid holding the concrete in cars longer than necessary. Concrete was poured directly into the footing forms from the cars whose bottoms sloped toward a side gate. To serve either right or left side of the tunnel, 4-cu.yd. standard dump cars were rebuilt so that the body proper could be set on the truck with the side gate on either side desired. The same cars were used for delivering concrete to the pneumatic

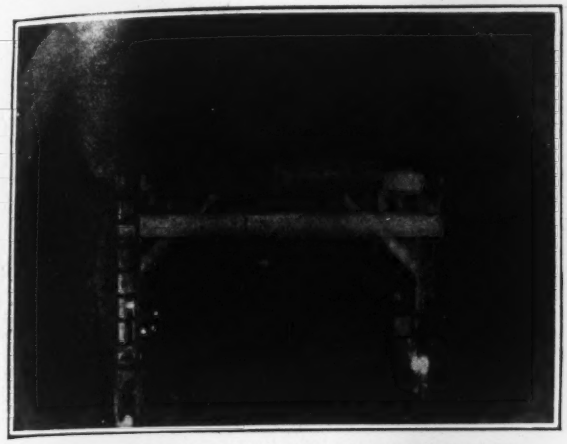


SECTION OF FORMS MOVING INTO PLACE

The 10-ft. gap between the end of the previous pour and the first section of the new "set-up" will be closed by the fifth section placed when the bulkhead can be removed.

gun, the design being such that the car bodies were set high enough to deliver their charge by gravity.

After the footing concrete had set, usually in about 5 days, the steel arch forms were placed in position. These forms, built in 10-ft. sections, were hinged at



MOVING STEEL FORMS IN THE SKAGIT TUNNEL
The footing bolts have been removed, the form collapsed and lowered by jacks on to the "jumbo" ready to be moved ahead.

two points well up in the arch, which allowed a section to be collapsed and moved ahead under sections still in place. The traveler used to handle the forms ran on the rails laid for the trim "jumbo" and carried on its deck four jacks to be used in raising and lowering the form sections.

The lower ends of the arch forms were secured to the footing concrete by means of the bolts already referred to, and shown in the accompanying picture. To remove the forms, the nuts were taken off these bolts, after which the two sides would be swung in on their hinges and the whole form lowered by jacks sufficiently to allow it to rest on the traveler and to pass through the adjoining forms still remaining in place. The traveler with the form section supported upon it was hauled ahead by means of an air hoist mounted on the traveler which carried the concrete gun.

Five 10-ft. sections were set up between each move of the concrete gun; the first of the sections was set 10 ft. ahead of the end of the previous pour and by the time four sections had been set the bulkheads could be removed and the fifth section placed in the gap. This gap appears in one of the pictures. The bulkheads finally found most convenient on this job consisted of short pieces of 1-in. boards one end of which was shaped and fitted to the irregularities of the rock when the form was set up and the other end of which was clamped by an angle iron, to the 6-in. end channel of the form. This plan gave a 6-in. bearing on the boards that served, with the aid of occasional bracing where the rock surface was not favorable, to effectively hold the vertical face of the concrete.

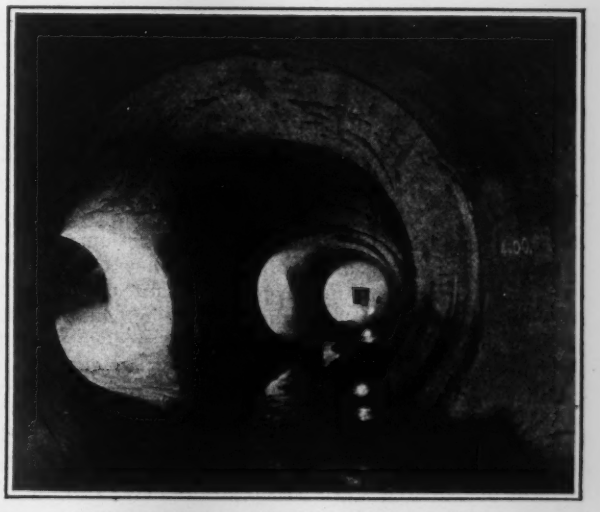
The concrete gun was set at one side of the tunnel and low enough so that concrete could be delivered to it by gravity from the 3-cu.yd. side-dump cars, each carload constituting a charge for the gun. The gun was found to be able to deliver its 3-cu.yd. batch and completely clear itself of concrete in one minute; thus the speed of concreting was limited to the capacity of the mixing and hauling equipment.

Concrete left the gun through an 8-in. pipe running on easy curves to the top center of the tunnel arch where at the beginning of operations in each "set-up" of the forms it passed over the arch forms for a distance of 50 ft. The discharge end of the pipe terminated midway in a rectangular metal box from which the concrete passed to either or both sides of the form through the ends of the box which could be opened or closed as desired. This box served as a baffle or stop to slow up the concrete and prevent it from being scattered over the arch form. Air which had finished its work escaped from the pipe without building up back pressure in an undesirable way, while the right-angle turn which the concrete had to make to pass out of the box slowed down the mass just enough so that when the air valves in the gun were properly handled the concrete would slide easily down the arch forms much as though it were delivered by gravity.

The 50-ft. length of discharge pipe was supported as a cantilever for its entire length, a timber truss extending part way to avoid excessive strains in the pipe itself. The weight of the entire rig from gun to discharge end of pipe was therefore carried on the traveler which ran on the track used by the form traveler and trim "jumbo."

With this rig and by moving the traveler as desired, it was possible to place concrete in the arch anywhere within a range of 50 ft. thus keeping it level and evenly distributed. This rig was moved in either direction by the air hoists previously mentioned, a small steel cable being passed around the drum of the hoist and the two ends made fast up and down the tunnel.

About 1,000 ft. above the power house the main tunnel, 20 ft. in diameter, branches into three 11-ft. tubes as shown. The 11-ft. lines consist of steel pipe riveted up in the tunnel and later incased in concrete. The photograph reproduced herewith was made with the use of four simultaneous flashlights, three in the penstocks and one behind the camera in the main tunnel.



PENSTOCKS BRANCHING OUT OF TUNNEL

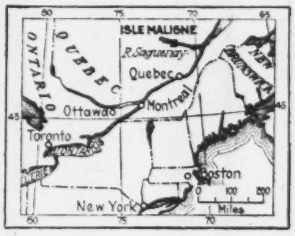
The work of driving the tunnel started in January, 1922, and the headings met Sept. 28, 1923. The concrete lining was practically all placed by May 1, 1924.

The work was done for the city of Seattle, C. F. Uhden being chief engineer of the Skagit project. The contract for the tunnel was held by R. C. Storrie & Co., for whom R. C. Hackley was engineer in charge of construction. Patent on the concrete gun has been applied for in the United States and negotiations covering foreign patents are under way.

Building a Hydro-Electric Plant on Saguenay River—III

Electrically-Driven Construction Equipment Used Entirely on Half-Million Horsepower Operation in Northern Quebec—Work Lasts Through Three Sub-Arctic Winters—30-Mile Service Railway Used

This hydro-electric power development, to total 1,200,000 hp., is being built in northern Quebec, under the construction difficulties that such remoteness and adverse winter temperatures imply. This is the last of three articles; the first in the issue of Oct. 16 was on "Developing Access and Habitation"; the second, Oct. 23, on "Installing Plant and Power."



The project is being carried out by the Quebec Development Co., Ltd., with J. B. Duke, president. The late Sir William Price was vice-president and chief owner with Mr. Duke. W. S. Lee is vice-president and chief engineer; and F. H. Cothran is vice-president in charge of construction. Work is being done by force account. —EDITOR.

III. Construction Progress and Methods

PERIODS of notable progress in a generally fast construction schedule are outstanding features of the Saguenay power operations. Uninterrupted prosecution of work in intensely cold winter weather is a secondary feature. It is to these two construction features that principal attention is directed. They too are the essential reason for the large-unit plant development previously described. In the routine of mixing and placing concrete, of excavation and of steelwork there is little demanding notice which is not an element of quantity production or of cold weather prosecution of work.

General Schedule—The circumstance has been noted that low water in the Saguenay is in March. The months of January-March, then, are the low-water quarter of the year. It is also to be noted that in volume of work and amount of construction time, the power house, including the tailrace, was the controlling operation. Within its construction period there was ample time to complete the other separate and much smaller structures. The power house then was the first point of construction attack and the first move was to lay the site open by cofferdamming the channel above and below. And the time to cofferdam the deep and swift flowing Saguenay rapids obviously was in the low-water quarter of the year.

So the construction of the upstream cofferdam was begun in January. At the same time work was begun on the connecting railway. The upstream cofferdam was completed in March. Then the downstream dam was put in and, in the summer and fall of 1923, while the railway was being put through and the plant installed, excavation of the dam site and preparations for concreting were carried through. These operations brought the time around to the 1924 low-water period when the second critical operation of blocking off the channel with the power house head wall had to be completed. As will be described later, it was finished in May.

FIG. 11—PANORAMA OF CONSTRUCTION OPERATIONS

During this summer of 1924 work has gone along on the power house and spillways to the point where as winter closes down water can be turned again through the north channel. The panorama, Fig. 11, shows the progress of construction on June 3, 1924. Then with the low-water period of 1925 the third critical operation of cofferdamming the south channel above spillway 4 will be put through. With this work completed, barring accident, the work of construction becomes largely the routine of large concreting and earth moving operation.

Cofferdam Construction—In both instances of initial closure of the river—for the power house and for spillway 4—the cofferdam construction is a rush operation in winter. Both the methods and the type of structure

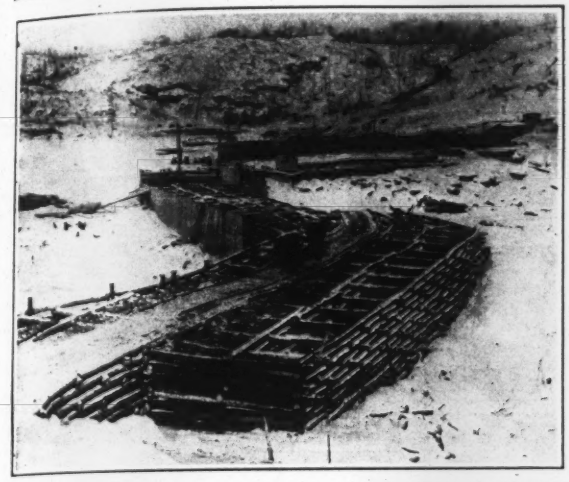


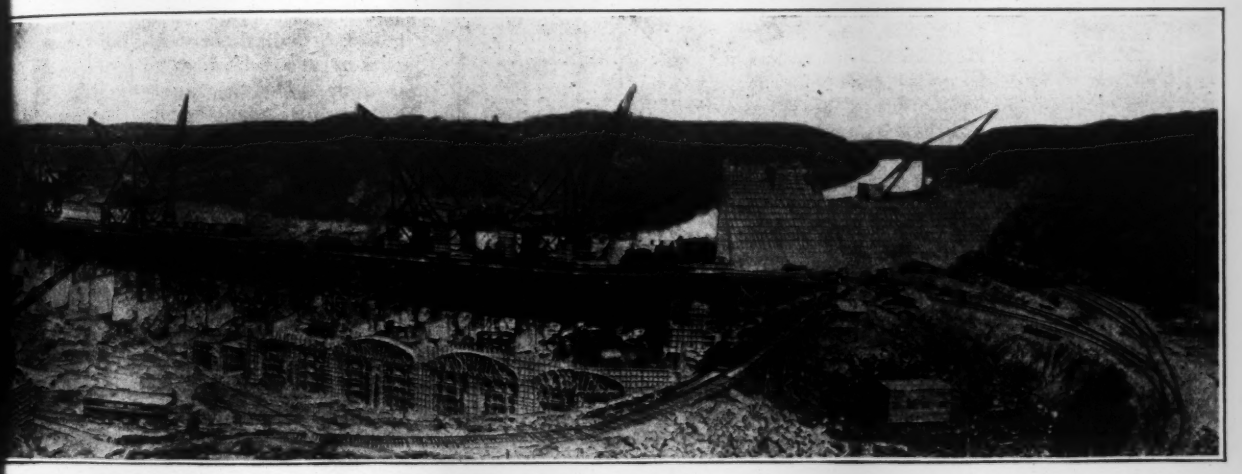
FIG. 12—BUILDING COFFERDAM ABOVE POWER HOUSE

employed for the power house cofferdam are planned for the dam for spillway 4. Considering the power

and supplies for the first winter's work, had to come in.

In shape, as indicated by Fig. 12, the dam was a flat V pointing upstream. It was built of stone-filled log cribs with a vertical sheeting on the upstream side. The length, end to end straight across the stream, was about 1,100 ft. Fig. 13 gives typical sections. As originally built the width nowhere exceeded 40 ft., but later the section was strengthened by adding 20 ft. in width at deep spots. The sheathing was two layers of 1½-in. tongue-and-groove boards. The river bottom was rocky and very irregular.

In general, construction followed the usual procedure. The structure was carried out from each shore by sinking successive cribs. The progress under difficult winter conditions is the notable feature. It is indicated by the diagram, Fig. 14. The filling of the cribs closely followed the sinking. A cofferdam of 17,868 cu.yd. displacement was put in in 60 days, exclusive of sheeting. This was during intense cold as indicated by Fig. 12, with all material hauled in by sledge and men and teams housed in a local camp. In methods, about the only procedure of note was the completion of the ice bridge across the middle channel,



NE, 1924, WITH CONCRETE WORK WELL ADVANCED

house cofferdam, the work had to be done in the low-water period of January-March. The stream was deep and swift, so swift that, despite the intense cold, ice did not cover the center of the current. Seldom did the temperature rise above freezing and for many days the mercury registered colder than zero, sinking frequently to —30 deg. F. In this first winter too there was no railway connection. All haulage had to be by sledge on snow roads. This was the manner in which the logs and lumber for the dam, indeed all materials

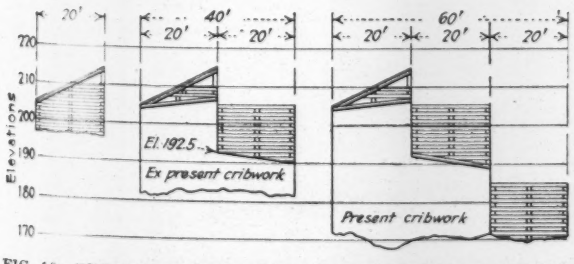


FIG. 13—TYPICAL POWER HOUSE COFFERDAM SECTIONS

normally unfrozen because of the swift current, by means of a brush boom which checked the current and permitted the frazil ice to set up.

Concrete Construction—Except the three spillways 5, 6, and 7, on the Little Discharge, all concrete is placed from the central mixing plant previously described. Four-yard buckets, four to a flat car, are hauled on service railway branches to the operations; there they are handled by fixed derricks for the spillways and by the derrick travelers for the power house. Except for the sizes of the units the general procedure is ordinary. The noteworthy operation is the continuous, year-around concreting schedule.

Methods of winter concreting are well demonstrated by the building of Block I, or the head wall of the power house. The power house section, Fig. 15, shows the several steps in which the concrete was placed. It also outlines the position of the trestle and traveler derricks. Up to track level the steel trestle remains in the concrete; above this point it is removed as Block 4 is concreted. The point of this diagram is that it demonstrates the derrick reach to every part of the

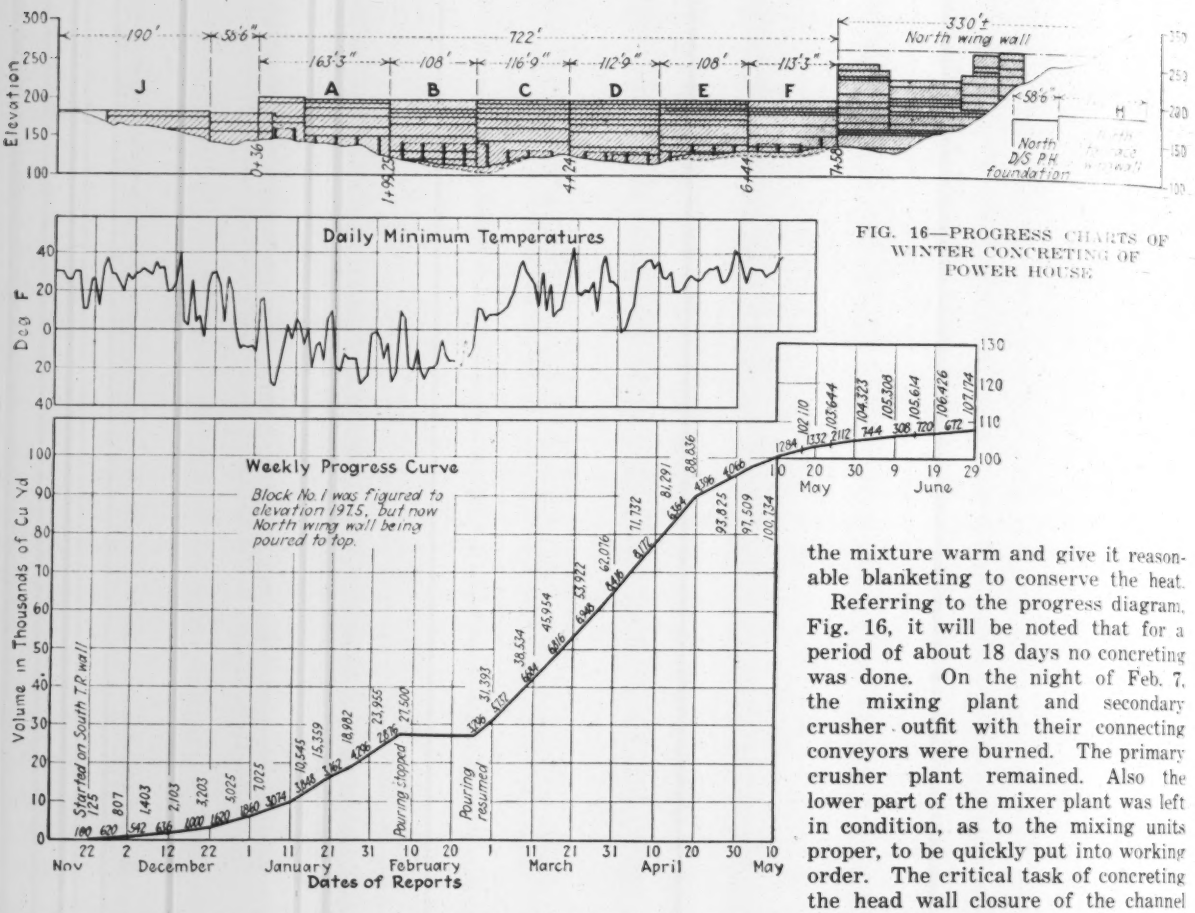


FIG. 16—PROGRESS CHARTS OF WINTER CONCRETING OF POWER HOUSE

structure and the enormous bulk of concrete yardage below derrick level, even below service track level. Perhaps no detail of the planning of the construction plant proper stands out more prominently for its economy.

By completing Block 1, the river was closed above high-water level. As stated, it was important to make this closure during the low-water quarter of the year and this was, therefore, the critical operation of the second winter's work. It meant also concreting in the depth of winter at a speed fast enough to get in something over 100,000 cu.yd. before the June floods. The diagram, Fig. 16, shows what was accomplished and under what temperature conditions. Virtually the entire volume of concrete was put in below freezing temperature and much of it at a temperature below zero, and no precaution was taken other than to deposit the mixture warm and give it reasonable blanketing to conserve the heat.

Referring to the progress diagram, Fig. 16, it will be noted that for a period of about 18 days no concreting was done. On the night of Feb. 7, the mixing plant and secondary crusher outfit with their connecting conveyors were burned. The primary crusher plant remained. Also the lower part of the mixer plant was left in condition, as to the mixing units proper, to be quickly put into working order. The critical task of concreting the head wall closure of the channel was in progress, and the first step in restoration was to get concrete again flowing into the head wall.

Pending full restoration the mixers were put into working condition. Coarse aggregate from the primary crusher was hauled direct to the mixers and put through them and into the structure. Temporarily all the inter-

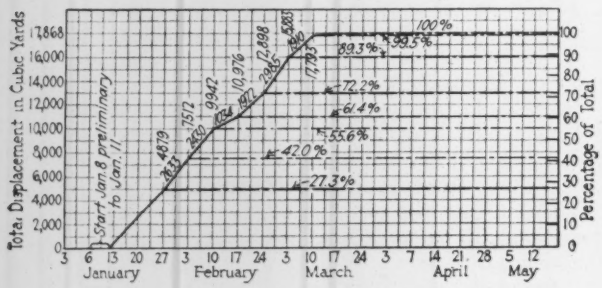


FIG. 14—PROGRESS CHART OF WINTER COFFERDAM CONSTRUCTION

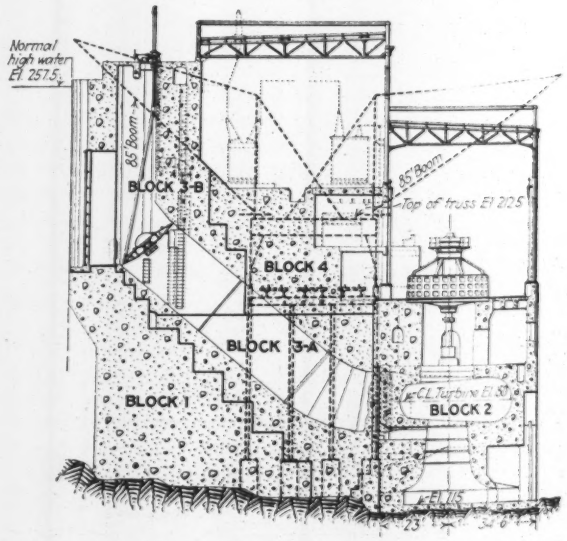


FIG. 15—SECTION OF POWER HOUSE SHOWING CONCRETING OUTFIT AND SEQUENCE

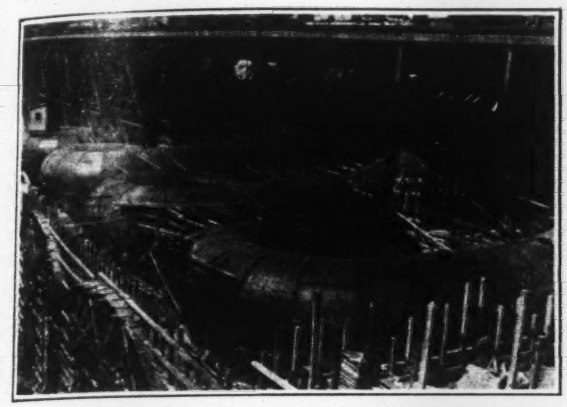


FIG. 17—SCROLL CASES IN PLACE FOR CONCRETING

mediate crushing and mixing processes were eliminated. The cement and sand proportions were adjusted to the large aggregate and in less than three weeks after the fire concreting was in full swing.

The concrete mixing plant was laid out, as previously described, particularly for winter operation. It was heated and steam plant was provided for heating materials. Virtually, however, the major effort was put into getting the heat into the water and not into the aggregate. Considerable experimentation was done but it all indicated that beyond keeping the sand and stone thawed out it did not pay to put much heat into them. Their specific heat, particularly that of sand, is low and fuel is better expended in heating the water. This was done. The concrete was turned out in 4-yd. batches and carried in full-batch buckets to the work where it was deposited promptly. Both the big batches and the big containers conserved the heat. At any rate there were no concrete faults due to frost in the whole winter's work.

In all the concrete work there was very little complex formwork. Turbine and motor emplacements and the water passages are for the most part plate steel units embedded in the concrete, Fig. 17. A view of the carpenter shop yard with form units made up and stockpiled is given in Fig. 18. Virtually all of the form fabrication was carried on in the shops, leaving only form erection for the field carpenters.

Excavation—Methods of excavation were ordinary. Using 60 per cent dynamite, the rock, a hard granite, was drilled and broken for steam shovel loading into cars with about ¾ lb. a cubic yard. Practically all the excavation is in two places of which the tailrace is the larger. Nearly all the tailrace spoil goes into crushed stone for concrete.

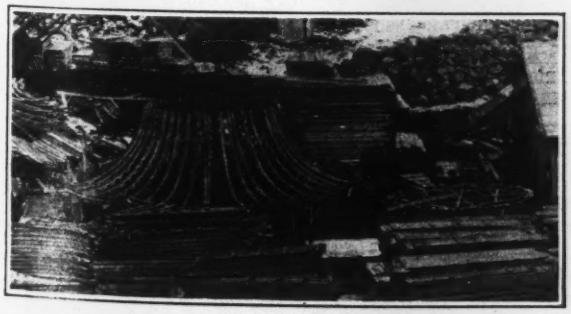


FIG. 18—SHOP MANUFACTURE OF FORM UNITS

Of earth excavation the only considerable amount is in building the dam which crosses off a gulley on Alma Island. The foundation is clay overlaid with muskeg 6 to 10 ft. deep. From the site a ditch to the river was blasted and is used as a flume for hydraulicking off the muskeg cover with an 8-in., four-stage, 520-ft. head centrifugal pump operated by a 400-hp. motor. The pump house is on the river bank. The dam proper will be built by trestle dumping along the edges and washing down to a cove pool—a semi-hydraulic fill structure. Borrowed material loaded by steam shovel and handled in 6-yard car trains will be used.

Hydraulic Efficiency Tests Made on 43,000-Hp. Unit

A SERIES of tests of the hydraulic efficiency of one of the hydro-electric generators at power house 2 of the Shawinigan Water and Power Co. at Shawinigan Falls, is reported by W. R. Way, chief system operator, in the October issue of *The Journal of the Engineering Institute of Canada*. The turbine is of the single-runner, vertical-shaft type operating under a head of 145 ft. at 138.5 r.p.m. The manufacturer's rating is 41,000 hp. The draft tube is of the Moody type with a short cone. The penstock is a rock tunnel 500 ft. long, 20 ft. in diameter and lined with concrete except in its lower end where it is lined with steel. The upper end has a gathering tube with five inlets and at the lower end there is a 20-ft. diameter Johnson valve with a 13-ft. outlet.

Two methods of testing were used: The Gibson, or pressure-time method (*Transactions*, Am. Soc. C. E., 1920, and described in a paper before the Am. Soc. M. E., Dec. 1923) and the Allen, or salt-velocity method, (described in a paper before the Am. Soc. M. E., Dec. 1923).

The points brought out by the tests were as follows: In the Gibson method tests; (1) The maximum turbine efficiency was found to be 91.0 per cent, (2) the turbine shows very high part-gate efficiency, (3) the maximum overall efficiency was found to be 88 per cent, (4) the total loss of head from turbine to headrace at the economical point of operation was measured to be 1.8 ft.

The main points brought out by the Allen method were: (1) The maximum overall efficiency is slightly over 87 per cent at 0.72 gate opening, (2) the maximum turbine efficiency is 90.9 per cent at 0.70 gate opening and 85 per cent at full load, (3) the Johnson valve may well be used as a Venturi meter to obtain a continuous record of flow of water under steady load.

In reviewing the tests the author draws attention to the facts that : (1) The maximum discrepancy in the curves of turbine efficiency is one per cent but is confined to only a portion of the curve. The values are practically identical at the point of maximum efficiency. (2) The power discharge curves show how consistently the points form a smooth curve. (3) No serious inconvenience was caused to the load on the system due to the tests. (4) The tests on the intake by the salt-velocity method show the remarkable accuracy obtained even with very short and irregular water passages. (5) The choice of either of these methods for measuring the water used may only be made after a complete study of the load conditions.

Soft-Ground Tunnel Accident at Milwaukee, Wis., Kills Four

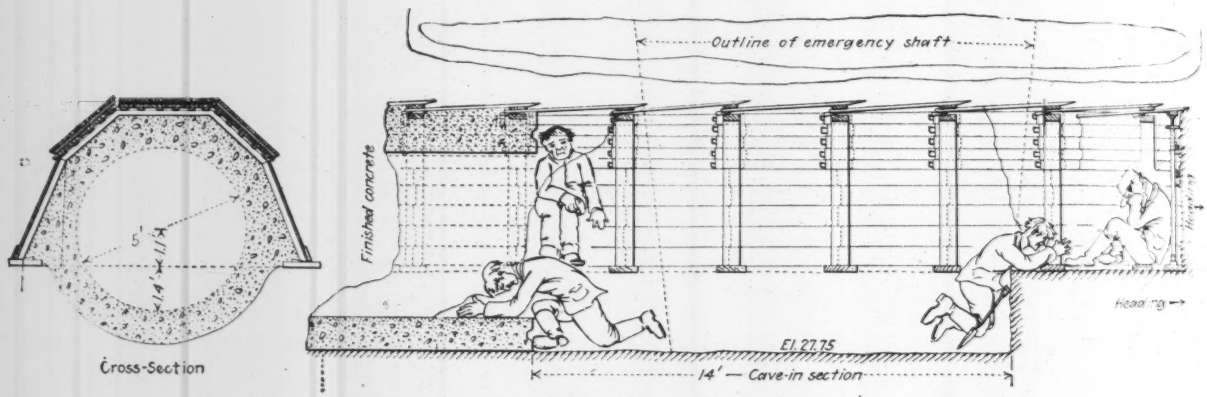
Saturated Sand and Gravel Formation Showing No Indication of Flow Caved in at Heading—Emergency Shaft Sunk for Rescue

A SLIP OR cave-in in the East Side sewer tunnel at Milwaukee, Wis., on Sept. 7, which resulted in the death of four men, was due to saturation of the soil by sewage leaking from an old pipe sewer, the saturation not being sufficient to cause a flow which would have indicated the danger. The above is the gist of a statement which has been furnished by T. Chalkley Hatton, chief engineer of the Milwaukee Sewerage Commission, and which is the basis of the following account of the accident. The East Side tunnel extends through the heart of the city and has a diameter reducing from 84 to 60 in. It has been driven through ground consisting of fine dry movable sand, quicksand, clay mixed with sand and gravel, hard pan and glacial drift. In some sections compressed air has been used under low pressures to overcome the water pressures.

The accident occurred in the 60-in. section, which was being driven through damp (but not wet) gravel and sand having just enough clay to form a partial binding. This character of ground had been encountered for several hundred feet and the contractor was using five-piece timber sets spaced 3 ft. apart, poling the sides and roof with 2-in. maple common lumber. The legs of the sets rested upon 2x10-in. blocks placed about 18 in. above the subgrade of the invert, on what appeared to be firm ground. At 5 a.m. the night engineer had visited the section to give line and grade, so that the invert might be dug out ready for the 7 o'clock shift to start concreting the 16-ft. section which would bring the finished sewer up to within 4 ft. of the breast of the tunnel, as had been the usual procedure. He inspected the timbering, as was his duty, found it properly placed and so reported.

About 1½ hours later, when the four men had about finished the excavation for the invert, the roof of the tunnel for about 14 ft. fell in without warning. One man was killed instantly. The night superintendent was trapped in the 4-ft. section next to the breast so that he died of suffocation before being taken out, and the other two men were caught so that their heads were free of the cave-in but their bodies were so buried as to be immovable. One of these men was taken out alive after fourteen hours, and died the next day. The other man died an hour before his body was found. The accompanying drawing, which shows the timbering and how the men were found, was prepared for the coroner's jury by the engineering department of the Milwaukee Sewerage Commission.

To get the bodies of the other two men without endangering the lives of the rescuers, a 14-ft. square shaft was dug from the top, over the cave-in. When 16 ft. down it struck an old 15-in. terra-cotta sewer with open joint, which was discharging most of its contents into the surrounding gravel. This gravel was well saturated, but not flowing. The cave-in had taken the dirt away from the pipe, leaving a large cavity under and over it of about the same volume as the fallen material. When the invert was excavated below the footing blocks the soaked gravel and sand slipped down just enough to loosen the sets, which allowed the whole timbering to collapse. No timbering was broken and the shoulder on one side of the tunnel upon which the foot blocks were resting was found intact, while the other side had slipped in.



TUNNEL CAVE TRAPS HEADING GANG

The work was being done by good contractors, Hammen & Co., Detroit, with experienced miners and excellent equipment. It is considered that this was one of those unfortunate accidents in tunnel construction through soft ground which are likely to happen without warning and in which no carelessness appears.

Directors Receive Gifts for A.A.E.

An acre of valuable land on the shore of Lake Erie, west of Cleveland, has been given the American Association of Engineers by Mrs. Alice T. Root, of Bay Village, Ohio, whose recently deceased husband was a member of the association. The principal derived from the gift, which is valued at $20,000, may be used as a nucleus for an association home. The board also accepted a gift of property in Georgetown, Colo., from a member who does not wish his name to be made public. The property consists of a house and two lots, and was given in the hope that the association could in some way derive benefit from the property as an outing place and summer resort for Association men seeking vacations. Georgetown is at an elevation of 8,500 ft. and is 51 miles west of Denver on the Colorado & Southern R.R. The property is accessible by two very good automobile roads.

One of a Series of Articles on the Details of Design and Layout of Different Types of Industrial Buildings

Special Design for Hosiery Mill on Pacific Coast

Axis of Line of Buildings Chosen to Eliminate Excess Sunlight—Bracing Against Vibration and to Withstand Earthquake Tremors—Layout and Column Spacing to Fit Machine Sizes

By John R. Poteat
Manager, Chicago Office, Lockwood, Greene & Co., Engineers

THE SUNNY climate of southern California was taken into account in laying out the axis of the new factory of the Theme Hosiery Co., recently completed in Los Angeles. Other features of this plant, which is the first on the Pacific Coast to manufacture a full line of hosiery, included separation of three different departments into as many buildings, working out a compromise on the column spacing to fit the larger machines in one case and eliminating columns by the use of trusses in another case, choosing a material to give rigidity against vibration, providing extra bracing against earthquake tremors, waterproofing certain floors against hot and cold liquids and providing an alternate of oil- or natural-gas-fed boilers.

As in any industrial plant the first consideration was the plant layout and its location on the site. In this instance the site was unoccupied, was triangular in shape with its apex to the north, and there was a variation of about 10 ft. in elevation between the center of the lot and the two sides. The development of this property to gain not only the most efficient occupancy of the land, but to make access to it easy and at the same time allow for the possible sale of part of the unused portion and for future expansion to more than double the original plant, was a matter requiring careful study. Drainage, water and service lines and the declination of the sun during the greater part of the year at this latitude, were largely responsible for the determination of the main axis of the various buildings of the plant. The maximum declination of the sun in Los Angeles is about 20 deg. Hence, the axis of the buildings was chosen at 22½ deg. south and east, this direction satisfying best the conditions of the site and eliminating the greatest amount of objectionable direct sunlight.

In a hosiery plant there are in general three main manufacturing departments: knitting and looping; dyeing and boarding; finishing and packing. Of course, the attendant departments for power, heat and water, the mechanical division, and the offices must be provided for. Segregation of the dyeing and boarding operations from the rest of the plant was desirable because of the steam and acid vapors and the more or less oppressive heat in these departments.

The housing of the whole plant in one building was at first contemplated since this arrangement almost always produces lowest first cost in a plant. The space requirements in the various departments did not, in this case, well divide into uniform areas for division on the various floors of the building. Therefore, it was decided to provide in general three buildings; building 1 for knitting, looping, finishing and packing; building 2, for dyeing and boarding, and builting 3 for boilers, pumps, softeners, etc.

Material passes from the knitting floors, fourth and third, of building 1, to the second, or looping floor, across a passageway to the dyeing in the second floor of building 2, to the first floor of this same building for boarding, then back into the first floor of building 1 for finishing and packing and shipment from the floor below.

As every plant must be built after a series of compromises so it is important to know what features can be compromised. Take building 1, for example. The apparatus to be housed occupies floor space of from 2 ft. square to a space 5x35 ft. for individual machines.

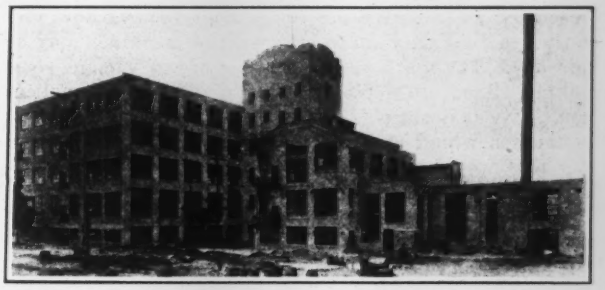


FIG. 1—PLANT OF THEME HOSIERY CO., LOS ANGELES
Buildings from left to right are main manufacturing building with offices in first floor and garage in basement; tower with elevators, toilets and water tank; dye house; pump house. Exterior has coat of cement plaster. Note temporary ends of hollow tile plastered to permit extension.

Which machines shall take precedence over all others in the fixing of column spacings? In this case the 5x35-ft. machines for full-fashioned hosiery were used, and the building laid out to them since the layout of the other machines could be accommodated easily to a column spacing which satisfies the full-fashioned machines across the building with aisles along the walls and down the center. This gave a width of 91 ft. 8 in. inside, or three bays 30 ft. 4 in., 31 ft. and 30 ft. 4 in. measuring inside. Since the machines are placed four per bay, running across the mill, two pair facing each other backed against the columns, accessibility to the rear of the machines necessitated one column on each side of the building instead of two, which would have cut down the span somewhat, but would have made accessibility of that part of the machines between the columns difficult.

The spacing along the building appeared best at 12½ ft. center to center of columns. Such a bay, 31x 12½ ft., did not work out economically for flat slab construction and the desired live floor load of 100 lb. per square foot also militated against it.

Concrete construction was desirable because of the delicacy of the machines and the necessity of perfect alignment. The rigidity of the concrete structure with its freedom from vibration or excessive deflection makes maintenance of the machines less troublesome and makes for a better product. It was therefore decided to use steel-pan construction with T-girders across the

building and concrete joists between the girders and a thin slab above. Considerable saving was made by the use of this type of structure, and in other plants of the same kind this construction has shown its superiority. To stiffen the building against the slight earth tremors of California the spandrel walls of the building were cast integrally with the exterior columns giving the effect of a deep beam.

In this building the story heights are as follows: Basement 11 ft.; first floor, 16 ft.; second, third and fourth floors, 14 ft. top to top. These heights allowed proper window area at sides effectively to light the entire floor. In the center bay of the basement the floor, which is at grade in the rear, was dropped to allow for a truck entering at grade in the front to load from the main floor level at body height.

Building 2, the dye house and boarding building, presented other problems. The machine layout dictated a building 41x54 ft., two stories and basement. The floor under the dyeing machines on the second floor must be waterproof so that water can be discharged directly from the machines to the floor for overflow, and so that the working space between the machines may be kept dry. The machines themselves are of various sizes making almost any column spacing difficult of application. It was decided therefore to eliminate all columns by trusses which at the same time were designed in a way that would stimulate the ejection of steam through the roof.

To solve the floor problem the slab for 13 ft. from the outside walls was dropped 24 in. to form a trench, while the center portion of the slab remained up. This lower

FIG. 2—TYPICAL STORY IN BUILDING 1, PARTIALLY OUTFITTED
Small seamless-hosiery machines. Girders run crosswise of building. Floor is maple laid on plank bedded in sand.

portion was waterproofed with a membrane and covered with an acid-proof mastic which was carried up over the center portion of the floor. This arrangement allows for more flexibility of the floor surface under the rapid temperature changes which occur when hot and cold water are successively discharged and protects the structure from the acids in the dyes. To provide an all-level floor surface 3-in. planks were laid with ¼-in. cracks around the machines and at the level of the center section. Below this false floor is carried all the water and steam and drain piping, which thus is rendered accessible and at the same time forms no obstruction. The story heights in this building were arranged as follows: Basement, 11 ft.; first floor, 16 ft.; second floor, 21 ft. to top chord of truss. These heights allowed sufficient volume in the rooms to absorb effectively and remove the heat rising from the processes.

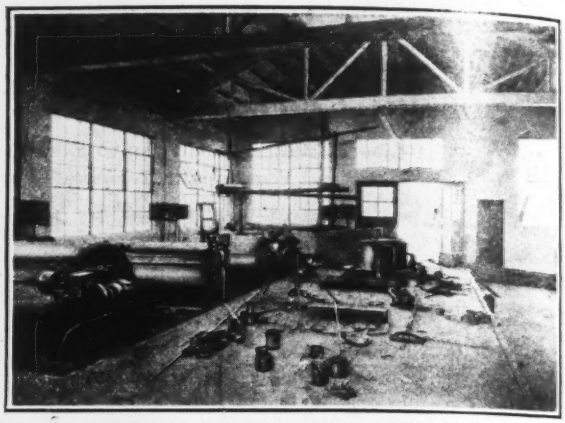


FIG. 3—SECOND FLOOR BUILDING 2, DYE HOUSE PORTION
Floor trenches before installation of all machinery and before false plank floor laid.

Building 3, the mechanical building, offered no serious problems, as it was provided for housing two 150-hp. boilers, feed water heater, boiler feed pumps, vacuum pump, water softener and circulating pumps. The boilers have burners which can operate with either natural gas or oil. Besides reliability, the alternate fuel allows the company to go to gas or oil as market conditions fluctuate. Oil storage is provided in two tanks buried in the ground at the north of the boiler room. Storage for salt for softeners and other mechanical supplies is provided in the basement of the building adjoining. The electric power used for the entire building is purchased.

The cost of the construction complete including all building equipment such as heating, wiring, plumbing, water supply and boilers was $3.47 per square foot.

The actual handling of the job, which was executed by the Chicago office of Lockwood, Greene & Co., Engineers, necessitated the placing of more than fifty different contracts due to the diversity of the items entering into the operation.

Land Drainage Decision in Wisconsin

ASSESSMENT of costs for supplementary drains is the subject of a recent decision by the Supreme Court of Wisconsin, noted as follows in the quarterly report of the *State Engineer:*

In the case of the Green Bay & Western Ry. *vs.* Brown County Farm Drainage No. 3, the Supreme Court held that the cost of construction should include the cost of all supplementary drains necessary "to adequately drain the lands proposed to be drained," and that assessed benefits should be correspondingly high in order to warrant such expenditures. Hitherto, drainage boards and commissioners have interpreted the laws to mean that from their standpoint "adequate drainage" requires only an adequate outlet for every farm. The landowners have been given an opportunity to install the supplementary drains themselves. This view has satisfied the landowners also.

Hereafter, the boards or commissioners must design the supplementary drains for the individual farms adequate for complete drainage in the project, and include the cost of constructing them in the assessment for construction against each farm. It may be that where a landowner is not ready to use such supplementary drains profitably if installed, their construction may be postponed by stipulation, and damage may be allowed to each parcel equal to the cost of the construction so postponed.

Recent English Endurance Tests of Steel and Other Metals

Comparison of Endurance Limit and Static Strength—Effect of Temperature and of Viscosity of Material

FATIGUE tests of steels of various grades carried on at the National Physical Laboratory (London) during the past year have developed some new data on endurance. A series of tests on specimens of different forms indicated that the volume of metal through which a given stress is distributed does not influence the result. These tests were made in a Wöhler machine, using hollow specimens under single-point loading, solid specimens under single-point loading, and solid specimens under two-point loading. The results showed remarkable agreement, the maximum divergence being less than 2 per cent. Steels of 0.13 per cent carbon and of 0.33 per cent carbon were included in this test. In other tests the strengthening effect of stress reversals just below the endurance limit was demonstrated in very marked form. Two specimens which had undergone 250,000,000 reversals without fracture were retested, increasing the stress in small steps and running 10 to 15 million reversals at each step; it was found possible to raise the stress 30 per cent above the original endurance limit before fracture.

Many tests have shown that the stress which produces fracture at or near 10,000,000 repetitions may be taken as the endurance limit, the figure so determined agreeing closely with other endurance-limit determinations.

Distortion—Relation of fatigue to distortion or flow of material was studied in a further series of tests in which speed effect, hysteresis, permanent set under low stress, and the like were studied. It was found that large plastic strain could occur in a specimen subjected to repetitions of a safe range of reversed stress. Under microscopic observation of the internal structure of the specimens it was shown that with every metal, under all stress ranges, formation of slip bands occurred in the application of safe ranges of stress, so that the appearance of the slip bands does not seem to be related to failure. There was no marked difference in the character of the deformations of the specimens under safe and unsafe ranges of stress.

Endurance tests of steel at high temperatures were reported before the meeting of the British Association for the Advancement of Science at Toronto last month by Prof. F. C. Lea and H. P. Budgen. With one steel, the experimenters found a considerable increase in endurance limit at 400 deg. C. as compared with the endurance at normal temperature. This was in alternating stress, i.e. with complete reversal of stress in every circle. When tests were made with repeated stress, the test piece being constantly under tension and the amount of the tension varied from a lower to an upper limit, the endurance range was lower for high temperature than for normal temperature.

The Lea and Budgen tests also showed some surprising comparisons between endurance and static strength. It was shown conclusively that the endurance limit is not identical with the "creep stress," but is higher. The creep stress is that unit load under which continuous plastic flow takes place. Thus, in the case of a 0.14 per cent carbon steel indefinite resistance to rupture was found under a repetitive tensile stress varying from the lower limit of 8 tons to an upper limit of 22 tons (British) per square inch, although at the 22-ton stress continuous creep is found under static load. In general, at elevated temperatures the endurance limit was found well above the creep limit. This creep limit at ordinary temperatures is above the yield-point, and is near the ultimate strength. The endurance range is nearly equal to the ultimate strength, or, in other terms, the endurance limit for reversed stress is about one-half the ultimate strength.

Plotting the results of endurance tests on a base of temperature, it was found that both the endurance range and the maximum stress in repetitive endurance tests remain almost constant with increasing temperature, at least to a temperature between 300 and 400 deg. C., then decreasing gradually according to a parabolic law. The static strength, however, decreases markedly above 300 deg. C., and there is decided lack of parallelism between the curves of variation of static strength and endurance strength with temperature. The ratio of endurance to ultimate strength, which at normal temperatures is equal to one-half, is therefore not constant. The value of the endurance range for a given mean stress decreases with increase of temperature, becoming zero at the temperature for which the mean stress is equal to the static ultimate strength.

Other Tests—At this meeting Prof. C. F. Jenkin gave a general review of fatigue work carried out for the Aeronautical Research Committee of Great Britain. Observations made by Gough at the National Physical Laboratory on the proportional limit of rotating endurance test pieces indicated that this limit agreed closely with the long-run endurance limit. Gough, Haigh and Griffith measured the rate of heat evolution of endurance test pieces, to determine whether the rapid rise of temperature due to hysteresis was an index of the endurance limit. In some metals (nickel, hard steel) they found several points of rapid heat evolution, none of which was related to the endurance limit, while in others (Armco iron) they found a steady increase of heat evolution, and no sudden increase. Heat generation was concluded to be no index of fatigue limit. Mason measured the rate of work input into the endurance test piece, by measuring the sidewise component of the deflection of the rotating piece; he found no sudden change in work input at the endurance limit. Lea found that when the proportional limit was raised by applying stress to a piece of metal, the endurance limit was raised also. The same fact was noted by Gough. It was also found that the application of repeated or alternating stress hardened the material.

Thomas studied the weakening effect of scratches, using very ingenious and refined methods to determine the depth and shape of the scratches. The sharpest scratch did not reduce the endurance strength by more than 30 per cent, decidedly less than had been expected. Correspondingly, tests at the National Physical Laboratory showed that the influence of keyways on the endurance strength of shafts is not as great as theoretical calculations of stress concentration would suggest.

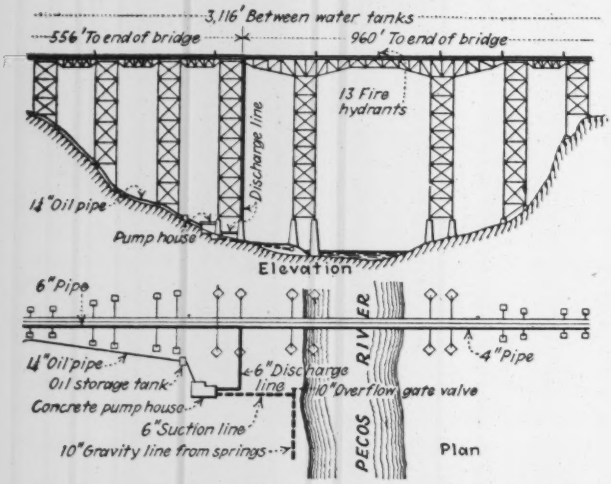
Much work has been done on attempts to explain fatigue failure. Jenkin brought out the theory that slip within the crystal grains composing the test piece brought about the endurance yield and final fracture.

Experiments by others showed this theory to be untenable, however. Griffith found that the endurance limit of Armco iron is above the yield-point. Gough and Hansen showed that slipbands result from motion in one direction only, rather than by motion in opposite directions as would result from alternating stress. The influence of viscosity of the material appears to be pronounced. Hopkinson suggested that endurance strength can be raised to near the ultimate strength of the material by making the alternations of stress very rapid. Jenkin has made endurance tests at speeds up to 120,000 alternations per minute, and has found the endurance limit to be increased by high speed. Viscosity, therefore, is most probably a factor in the phenomena of endurance resistance.

Experiments are being made on the endurance strength of vitreous silica (Griffith) and upon sealing wax and bakelite (Jenkin).

Railway Pumping Station Working Under 335-ft. Head

A PUMPING plant working under a head of about 335 ft. and against a pressure of about 150 lb. is the exceptional feature of a water station on the



HIGH LIFT PUMPING PLANT AT PECOS VIADUCT

Galveston, Harrisburg & San Antonio Ry. (Southern Pacific System) at the Pecos bridge, in Texas. This station, shown in the accompanying drawing, serves two elevated tanks for locomotive supply.

Water from three springs along the bank of the Pecos River is carried by a gravity line of 10-in. wrought-iron pipe, 2,750 ft. long, to the 6-in. suction line of the pump, the suction lift being 17 ft. At the end of the 10-in. line is an overflow gate valve. The pump house is located at the foot of one of the steel towers of the bridge, the 6-in. discharge line being carried up one of the columns from El. 706 at the pump to the deck of the bridge at El. 1,000.5.

The length of the bridge is 1,516 ft. From the head of the riser pipe two lines are laid along the bridge; a 6-in. line is laid east for 850 ft. along the deck and subgrade to supply a 100,000-gal. tank; a 4-in. line runs 2,360 ft. west to a 65,000-gal. tank. All these lines are of standard wrought-iron pipe and fittings, with screw couplings, and in six years of operation there has been no difficulty in keeping tight joints. Along the pipe lines on the deck are thirteen hydrants with hose coils for fire protection.

In the pump house is a 50-hp. vertical oil engine belted to a countershaft having a pinion which engages the spur wheel on the crankshaft of a horizontal duplex pump with cylinders 7x12 in., the pump capacity at 75 strokes per minute being 300 gal. per minute. A small air compressor charges tanks at 125 lb. pressure for starting the engine. Near one end of the bridge is an underground 6,500-gal. oil tank, from which a 1¼-in. pipe is led down the slope to a supply tank at the pump house. This plant was designed and built under the direction of H. M. Lull, chief engineer, Southern Pacific Ry. (Texas and Louisiana Lines).

Remarkably Heavy Plate Girders in Skew Railroad Bridge

Buffalo Road Crossing Requires Girders Weighing 130 Tons Each—Heavy Flange Sections and Web Reinforcement

SEVERE requirements were met in planning a double-track railroad crossing at Depew, near Buffalo, N. Y., to carry a track connection of the New York Central R.R. between its main line and the West Shore R.R. tracks. The required span and the sharp skew of the crossing, together with the ballasted solid floor construction which it was desired to use and the extra floor width required on account of the curvature of the track, combined to make a very heavy structure necessary. The length of the span is 118½ ft. center to center of bearings. Ordinarily trusses would have been used, but the great skew would have made the portal bracing of a truss bridge very long and inefficient. Plate girder construction was therefore adopted, although the possibilities of this type had to be pushed virtually to their utmost to meet the conditions. In consequence, the main girders weigh 130 tons each, and are probably the heaviest ever built.

Two views of the completed crossing and a drawing of the girder construction, Fig. 3, explain the conditions of the case. A small-scale plan of the crossing in Fig. 3 indicates the skew arrangement with respect to the road crossing below. To give a solid floor as required for a crossing over a street, transverse floorbeams are spaced about 16 in. on centers; each consists of a 27-in. I-beam weighing 90 lb. per foot. A continuous $\frac{7}{16}$-in. deck plate riveted over these beams and a waterproofed reinforced-concrete covering slab on this plate, with a protection layer of concrete over

FIG. 1—ELLICOTT ROAD CROSSING

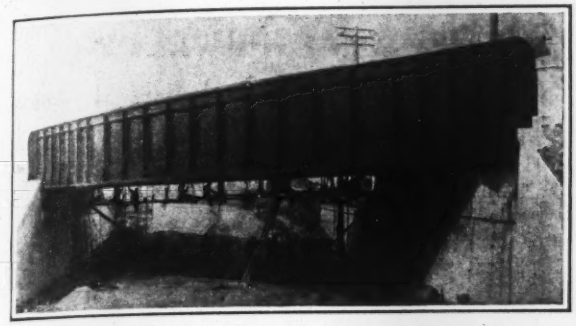


FIG. 2—MAIN GIRDER WEIGHING 130 TONS

the waterproofing, carry the ballast. This construction follows standard New York Central practice. The floorbeams rest on the lower flange angles and are riveted to the sides of the flange by end connection angles, but the riveting in this connection is proportioned to take the full end reaction without dependence on the bearing on the flange angle.

The large required flange section is provided by both side plates and cover plates. The side plates of the bottom flange were made sufficiently deep to receive the floorbeams; those of the top flange were made narrower and were supplemented by a pair of longitudinal angles along the lower edge. The bending resistance of the complete section was computed by moment of inertia. Rivets of 1-in. diameters were used in assembling the girders. In detailing the riveting the rivet values were reduced both for number of plates connected and for length of grip in excess of 4 in., under the regular specification clauses of the road.

As the girders are loaded unsymmetrically, because of the skew of the bridge, they have a much heavier reaction at one end than at the other. Web reinforcement was necessary at the heavy end to take the shear. This consists of a $\frac{7}{16}$-in. plate, on the inner side of the web. The flanges, however, are symmetrical about the single web, the web reinforcing plate taking the place of the inner flange plate of the girders.

Maximum depth as limited by shipping possibilities was chosen for the girder. This is usually 10 ft., but in the present case the limit was carried up to 10½ ft. depth of web, or 126½ in. over flange angles, making the total depth of girder about 11½ ft.

The bridge was built under the direction of G. W. Kittredge, chief engineer, and J. W. Pfau, engineer of construction. The design was prepared in the office of H. T. Welty, engineer of structures.

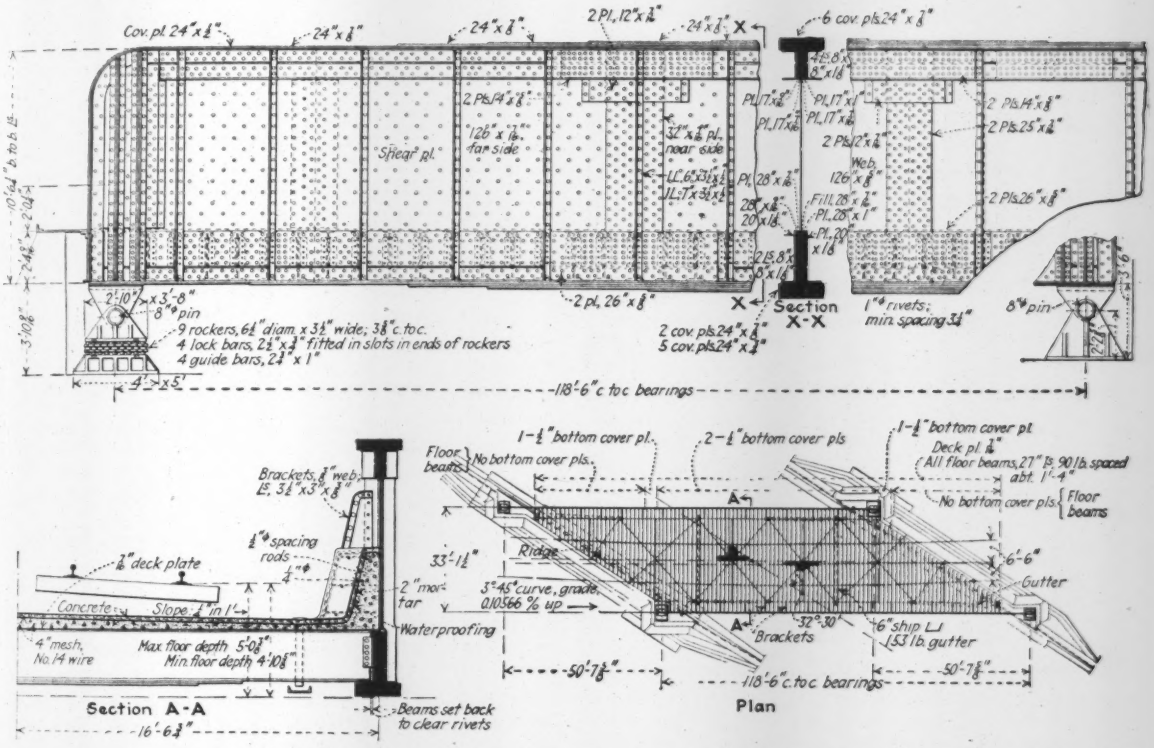


FIG. 3—GIRDER CONSTRUCTION WEB HAS REINFORCING PLATE AT ONE END TO TAKE THE HEAVY SHEAR

Montreal Has New Grain Elevator

A grain elevator with a daily capacity of 1,200,000 bu. has been put into service by the Montreal Harbor Commission at Maisonneuve. It has been constructed on a different principle from other elevators at the Port of Montreal, as light and ventilation have been made outstanding features throughout to insure cleanliness and reduce explosion hazards. The present storage capacity is 2,000,000 bu., but the equipment is designed to handle 10,000,000 bu., so that the plant can be expanded to store that amount without changes in the machinery. Five shipping berths make it possible to load five ships simultaneously.

Civil Engineers Fall Meeting Stresses Technical Side

One Whole Day at Detroit Devoted to Discussing St. Lawrence and Next Day to Simultaneous Sessions of Four Technical Divisions—Joint Meeting With Public Health Association

MORE ATTENTION was given to technical discussions at the fall meeting of the American Society of Civil Engineers at Detroit, Mich., Oct. 23-24, than in any other recent meeting of the society. The American Public Health Association met in Detroit earlier in the week and Wednesday afternoon was devoted to a joint session of the Sanitary Engineering Division of the American Society of Civil Engineers with the Sanitary Engineering Section and the Laboratory Section of the American Public Health Association. The report of that meeting is in this issue under the report of the latter association. All day Thursday was devoted to a discussion of the St. Lawrence deep waterway to the sea, and on Friday morning four technical divisions—those on power, sanitary engineering, city planning, and highways—met simultaneously in different parts of the hotel. Saturday morning the city planning division continued its session. Entertainment comprised a dinner at the hotel on Thursday night, a dinner at the Detroit Yacht Club on Friday night, various trips to the Ford plant, Detroit Edison, municipal plants, and the Wayne County highways on Friday afternoon, and an all-day excursion to Ann Arbor on Saturday, with the Michigan-Wisconsin football game as the final attraction. Nearly 500 members and guests were registered, but the average attendance at the technical divisions was around 50.

No business was transacted at the meeting, nor did the earlier meeting of the Board of Direction yield much in the way of news. So far no secretary of the society has been elected by the Board of Direction to succeed the late John H. Dunlap.

St. Lawrence Waterway—The main paper on the St. Lawrence waterway was presented by Francis C. Shenehon, consulting engineer, Minneapolis, Minn. This paper, which was available at the meeting in preprint form, took 72 pp. and is filled with maps, drawings, and diagrams. Mr. Shenehon quite successfully abstracted it in the short period of one hour allotted him. The paper is a general description of the whole St. Lawrence problem. It describes the physical conditions precedent to the problem, that is, the general topography and hydrology of the Great Lakes from Duluth to the sea, and the artificial improvements which have been added by man both to aid navigation and to produce power.

The general thesis of Mr. Shenehon's paper, in his own words, is "That the development of water power co-ordinately develops and subsidizes a navigable waterway," and from that thesis he suggests the various ways in which both navigation and power can be benefited. His major contention is that regulating works should be built along the entire lake system, considering each of the separate lakes as a separate reservoir with intervening controlling works, by which the surplus waters of the upper lakes could be fed as required by both navigation and power into the lower part of the system. In other words, his belief is that navigation can be better improved by raising the level of the lakes than by lowering the bottom of the lakes at critical places, and at the same time this lowering of the level of the lakes will create a more uniform prime power availability.

H. DeB. Parsons, consulting engineer, New York City, was the first discussor of the paper. Mr. Parsons' main plea was that the engineering problem of the Great Lakes development was far less important than the economic problem, and he therefore recommended that a new commission be appointed thoroughly to investigate the economics of the whole case. He repeated the well-known arguments against the lakes-to-ocean waterway as a navigation possibility. These comprise the statements that there will be no return freight, that ice and fog make poor navigability and increase insurance risks, that it is a question how much saving there would be in not having transshipments, that the costs will be very much greater than have been estimated, particularly because the harbor costs will have to be so greatly increased, and that there is a doubt that there is a possibility of a composite ocean-lake carrier. Mr. Parsons believes power is paramount and should be developed immediately, presumably at private risk under government control. Whatever navigation can be developed by this development of power should then follow.

Prof. H. C. Sadler, University of Michigan, expert on naval architecture, contributed a stimulating discussion to the problem of ship design for lake and ocean navigation. Professor Sadler is convinced that the lakes-to-ocean waterway is a necessity and that the design of the ships for it can readily be met. He pointed out that 90 per cent of the commerce of the world is carried on less than 30 ft. of draft, and that the draft for most of the freight is not required to be more than 25 ft. He pointed out also that the percentage of time lost in getting up some of the narrow channels and canals of the waterway is insignificant. Delays are common in ocean traffic. Load is superior to speed. This applies also to seasonal operations. He said only the large interocean port traffic is non-seasonal. Most of the important trade routes of the world are seasonal. In citing load superiority over distance he called attention to the Pacific-Atlantic sea voyage, which is now getting considerable of the business, though much longer than the transcontinental rail. He admitted that ocean-going vessels could not compete with intralake vessels, nor the lake vessels he operated on the sea; but he said that no peculiar type would be required to get up the lakes from the ocean and that when the time came the naval architects could well meet the situation.

L. C. Sabin, the United States assistant engineer at the Soo, emphasized the view that navigation was more important than power. He thought that the lakes-to-ocean waterway was fully justified solely for navigation. He criticised Mr. Shenehon's regulation scheme because he said it required omniscience as to demand downstream. He said that it seemed to him improbable that they could so clearly predict future needs as to feed the water when required.

Three Canadian engineers were on the program to

discuss the Shenehon paper, but President Arthur Surveyer, of the Engineering Institute of Canada, and J. B. Challies, recently director of the Dominion Water Power Branch and an important government official who has just gone into private power work, both notified the society that they would be unable to attend the meeting. Thomas H. Hogg, the hydraulic engineer of the Hydro-Electric Power Commission of Ontario, however, spoke. He took decided exception to some of Mr. Shenehon's criticisms of the Canadian attitude toward the St. Lawrence problem. He particularly criticised Mr. Shenehon for bringing the Chicago drainage canal diversion (which Mr. Shenehon had at least by inference defended) into the discussion. A lively verbal argument between Messrs. Shenehon and Hogg developed, but it did not contribute very much to the understanding of any of the technical problems involved.

Two defenders of the Chicago diversion emphasized the danger to the health of Chicago by the removal of the Chicago drainage canal diversion, though each discussion was confined only to that point and did not take up any of the contingent circumstances of the Chicago diversion.

Highway Division

Two aspects of the very live problem of highway traffic were discussed in the session of the Highway Division. The first was transportation surveys, as related both to road planning and to pavement design; it was discussed by J. G. McKay, chief of the Division of Highway Economics of the Bureau of Public Roads, W. A. Van Duzer, of the Pennsylvania Department of Highways, and H. G. McGee, director of the Municipal Research Bureau of Akron. The second was traffic regulation, which developed discussion of striking interest, led by J. N. Mackall, chairman of the Maryland Road Commission, G. C. Dillman, chief engineer of the Michigan Highway Department, and Prof. A. H. Blanchard, of the University of Michigan.

Transportation Surveys—Results of the California and Connecticut traffic surveys were reviewed in outline by Mr. McKay, and the Pennsylvania survey by Mr. Van Duzer. The two first-named surveys show nearly 50 per cent traffic increase in two years, and Mr. McKay expects that almost this rate of increase will be maintained for several years, after which there should be a flattening of the growth curve. Weighing of vehicle wheel-loads as a supplement to counting has been facilitated by the development of two types of portable scale within the last two years, so that extensive data on wheel loads are now available. These show that the very large majority of freight wheel loads is moderate, but that a small number of excessive wheel loads is always present. The results of weighings on a given road constitute a direct basis for pavement design. The data also point to the importance of controlling overloads, which have been found to be surprisingly numerous in some regions and very serious in their effect upon life of pavement. It is found that load regulation has succeeded in greatly reducing the overloading in Connecticut while the California attempt at regulation has not been equally successful.

Using the traffic data obtained, and taking the average fuel cost of vehicles on concrete and well maintained earth roads as 1c. and 1¼c. respectively, it is found that the fuel savings alone on the 360 miles of improved road in Connecticut, under present traffic, are sufficient to pay interest on the cost of the pavements and amortize the cost in 20 years. This high rate of return on the highway investment, Mr. McKay holds, proves the advisability of current financing, as against bonding, for road improvement. A combination of vehicle license fees and gasoline tax should produce the required fund.

Mr. McGee pointed out some shortcomings of traffic surveys and questioned certain current beliefs as to their value. Economic conclusions in particular require long-time records, which are not yet available. Continuous traffic count by mechanical means should be provided at important points to give such records. Results should be analyzed to determine how they correlate with the concentration of population and other potential factors of traffic production. The economic meaning or value of the census results also remains to be determined.

Traffic Regulation—Commissioner Mackall denounced as faulty the present-day practice in control of road-traffic evils. The causes of accidents are not known, and even skilled traffic officials, by sheer habit, erroneously ascribe accidents to speed. The prime obligation of highway and traffic officials is to speed up traffic rather than slow it down. Commissioner Mackall stated that he *favors the elimination of the maximum speed limit under all conditions.* More than this, he urged the abolition of all the multifarious traffic laws, substituting for them a law against reckless driving. He would take away the occupation of the speed cop, who does not promote traffic safety or help traffic to move, and compel this officer to find and arrest reckless drivers. In answer to a question, the commissioner defined reckless driving as operating or halting a car in such a way as to jeopardize drivers who operate according to the rules of decency.

Other points touched in his address are the movement for laws requiring road vehicles to make a full stop at railroad crossings, and the urgent necessity of checking the overloading of trucks. He declared that full-stop laws would result in a tremendous economic loss, and he advocated placing a flasher controlled by the approaching train at every unprotected crossing. Discussing overloading, he referred to the extensive failure of California roads a few years ago due to unregulated truck loading, with a resulting loss infinitely greater than the gain, and also to the failure of a road between Baltimore and Philadelphia due to unrestricted loading in Maryland. Analysis of traffic on this road showed that the elimination of very heavy trucks might involve a cost of $15,000, against a repair cost of $600,000 made necessary by the damage which these trucks did.

Reverting to the urgent necessity of speeding up traffic, he described the 15-mile driver as a reckless driver and proposed that on Sundays the main roads should be barred to any vehicle that cannot go at a speed of 25 miles per hour.

Mr. Dillman, outlining the essentials of road safety and traffic control, included these: Adequate maintenance, to keep the roads safe; proper marking and signs; state laws; checking of incompetent driving; efficient policing, preferably by a state police system; and uniformity, which he declared to be almost the keynote of the promotion of traffic safety. Center-line marking on roads has been found to be highly worth-while.

Professor Blanchard held that the weak spot of traffic regulation is enforcement, and advocated, in place of the present costly and inefficient method of arrest and

arraignment, a police traffic bureau system such as has been established in several cities. Under this system a traffic officer summons an offender to the police station, where, if the offense is admitted, a fine is paid to a record clerk, the amount of the fine depending on whether it is the first, second or third offense ($1, $3, $5 or $10). Offenses after the third are sent to court. In any event the offender has the privilege of taking his case from the police traffic bureau to a regular court.

Additional points of importance were brought up in the general discussion. Frank F. Rogers, highway commissioner of Michigan, expressed himself in favor of the uniformity both of laws and of markings, as against the present confusing diversity of practice. Mr. Dillman pointed out a possibility of danger resulting from confusion between flashers used at road curves and the like and flashers used at railroad crossings. Professor Blanchard finally made a strong appeal for action on grade-crossing protection. He declared that the railroads are definitely banded together to put over a full-stop regulation. The Hoover traffic-control committee had such a prohibition in the first draft of its report, though it was later eliminated. The 10-mile speed regulation of Michigan is nearly as pernicious, as it can be lived up to safely only by large cars, but creates danger for some types of small car. A 15-mile limit is the lowest practical operating limit for such a purpose, in his opinion.

Power Division

In the Power Division the discussion centered on the work of the committee on ice-problems at hydro-electric plants. It was opened by the familiar exposition of ice formation by John Murphy, of the Canadian Department of Railways and Canals, wherein the behavior of water around the freezing point is exhibited in experiment. The fundamental part of Mr. Murphy's theory on ice formation is that the water must be kept a little above freezing and the structure to which ice may adhere, the same. This means that a small amount of heat may prevent ice formation.

In the discussion John R. Freeman devoted his remarks principally to nucleation. Experiments had showed that the forming of frazil around some nucleus could be detected as the color of the ice, when rising to the top, was more yellow. He was of the opinion that there was some difference in the crystalline structure of frazil and anchor ice. He agreed that a small amount of coal or electrical energy was required to prevent frazil.

Thomas H. Hogg of the Ontario Hydro said that one of the most frequent troubles arising from frazil ice was the blocking of racks. Where means cannot be taken to prevent the formation of frazil ice and its deposit on the racks, and in cases in northern latitudes where the racks are carried on supporting structures, the latter always should be designed to withstand the full head which might come from complete blocking of the racks.

Various means for preventing the accumulation of frazil ice on racks have been tried, one of them being the passing of steam through hollow rack bars to keep the metal slightly above freezing temperature. This has met with only small success, as the openings in the rack bars tend to block up and the steam pipes to leak, causing an excessive use of steam and cold portions of rack to which the frazil ice adheres. Another expedient for warming the racks has been the passing of a current through the racks, but this also, as well as the use of wooden racks, has been found to be only partially successful. In all northern latitudes, if built in the open, the top of the racks should, of course, be kept below low water level, or a building which can be heated to a few degrees above freezing placed over the rack openings. This is effective in preventing rack blockage. In some plants the pulling out of the racks during the time of frazil ice has been resorted to, but this method subjects the turbines to the danger of any foreign matter which may be in the stream.

The best means of preventing trouble from frazil or other forms of ice is, in Mr. Hogg's opinion, a large headwater pond with a low velocity which will freeze over in winter time. If such a condition can be secured no trouble from ice need be expected, even in the extreme northern latitudes.

Various means of preventing the entrance of anchor ice into the turbines have been employed, such as ice skimmers, leading to a chute or other disposals, curtain walls, overflow walls. Another later expedient has been the use of a series of gathering tubes on the river bottom by means of which the water required is withdrawn from over a large area with such small downward velocity that the suction is not sufficient to overcome the buoyancy of the floating ice. This type of intake in conjunction with the usual curtain wall is equally effective against cake ice which is perhaps the greatest source of trouble on the Niagara River.

An interesting comparison was made of the ice problems existing on the Niagara and St. Lawrence Rivers. For the latter it appeared that the most effective means for combatting the ice was to prevent the formation of ice jams or packs by maintaining an open water channel throughout the full length of the power reach. In conjunction with this plan of keeping the ice constantly in motion, the various structures should be located so as to offer the minimum of obstruction to the flow of ice in the stream. Observation has shown that the flowing ice tends to follow either one shore or the other depending on the direction of the wind. By locating the power house approximately parallel to the main flow and in mid-stream and with the provision of wide sluice gates at either end, means for handling a flow of ice under all conditions with the least possibility of accumulation in front of the power house can be provided.

James S. Bowman, of the Fargo Engineering Co., Jackson, Mich., gave some interesting information on eliminating ice trouble at spillways. The general method of attack has been to apply heat to the affected parts either by steam direction against the ice by portable pipes or supplied to steam chamber built on the face of the gate, or into the piers along the line of gate travel; by the insertion of electrical space heaters in a housing against the downstream face of the gate; by the discharge of air under low pressure just upstream from the gate at sufficient depth to cause the warmer water at the bottom of the steam to be carried upward along the gate to prevent freezing.

The common method of using steam was to force live steam through a pipe or nozzle against the ice. This process is wasteful of heat, slow and requires a great deal of labor and physical force, but is perhaps the only method of handling the situation where the

gates have been frozen in all winter and no other equipment is available. By building steam chambers against the downstream face of the gate and into the face of the piers along the line of gate travel, steam could be applied in an economical manner. However, where temperatures are low and the winter season long, steam must be supplied continuously if trouble is to be avoided in the spring. Under isolated conditions where frequent inspection is difficult, electrical heating might be found preferable to other methods.

Sanitary Division

Recent developments in English sewage treatment, largely experimental at Birmingham, Sheffield and Manchester, show careful long time studies under way, said R. L. Sackett, dean of Pennsylvania State College. Points made were that activated sludge seems to have come to stay but other mechanical methods of agitation are being devised and tried out in the hope of cheapening the process as otherwise the effect on the overhead is serious; large sums are being invested nevertheless.

In discussing Langdon Pearse's description of the treatment of the sewage of Chicago, George W. Fuller called attention to the time interval between inception reports on sewage plants and construction; 17 years at Providence, R. I.; 30 years for the Passaic Valley; 38 years at Worcester, Mass. The first report on the Sanitary District of Chicago was in 1886. Prof. Stephen A. Forbes, University of Illinois, outlined, as his part of the discussion, the ebb and flow of biological forms in the Illinois River in 19 years. Chicago sewage diluted has not extended beyond the Peoria Lakes, he stated, except for the period during the war when the stockyards heavy "kill" increased the industrial load.

Clarence W. Hubbell, consulting engineer, Detroit, outlined the sewage-disposal problem for the 1,500,000 people in the Detroit area. Intercepters costing $40,000,000 have been constructed leading in general to proposed disposal sites but no plants have been constructed in the city. Ten plants for neighboring cities care for 10 per cent of the population, the largest being for 56,000 people at Spring Wells. The Pontiac plant built by Mr. Hubbell for 52,000 people with Adams rotating distributors over 110-ft. circular sprinkling filters was inspected by many of the sewage experts in attendance. An interesting observation in the study of river pollution and dilution was that the current prevents horizontal dispersion. The sewage even in the lower reaches does not extend to the center of the river.

For three years George H. Fenkell has been working out a future supply for Detroit. The plan contemplates withdrawing water from a point near the present intake and by tunnels carrying it to the west and north under the city to pumping and filter plants near the centers of distribution.

City Planning Division

This division had the longest program, extending over two mornings and comprising fourteen papers. The first day's session was devoted to "Factors in the Zoning of Cities," and the second to "The Influence of Zoning on the Design of Public Utilities."

The elements in zoning were discussed the first day. The opening paper was a long one by Prof. George C. Whipple, of Harvard University, entitled "The Health Bases of Zoning." The theme of the paper was that fundamentally health considerations govern the necessity for zoning. "The primary object of zoning is (1) to protect the basic phases of life against injury by providing adequate place-separation of residence, business, and industry; and (2) to prevent the private monopoly of natural light and air, necessary to health, by restricting the height and bulk of buildings in ways appropriate to their neighborhood."

With these general principles in mind, various factors involved in the problem, namely, light, air, noise, odors, congestion, and the like, were shown to be vital necessities in the promotion of public health and their beneficial effect on that health indicated.

Following Professor Whipple's paper the aspects of zoning for various purposes was discussed in several papers; for use, by Edwin A. Fisher, of Rochester, N. Y., citing the ordinance of that city as an example; for height by Jacob L. Crane, Jr., of Chicago; for area by Harland Bartholomew, of St. Louis; and for building line by Lawrence V. Sheridan, landscape architect of Indianapolis, and T. Clyde Hoffman, attorney for Indianapolis City Plan Commission. The final paper by Morris Knowles, of Pittsburgh, entitled "The Purpose of Zoning Ordinances and Methods of Administration," called attention to some of the administrative measures in zoning and pointed out the lessons derived from his experience. Mr. Knowles said the process of zoning should be as follows: Start right, have a comprehensive enabling act, carefully study and prepare all data, have thorough discussion with every one affected, have capable and honest administrative officials, and interpret special causes in particular cases by competent boards of appeal.

About 30 engineers remained to attend the second session of the city planning division on Saturday morning which had scheduled seven papers on the influence of zoning on the design of public utilities, such as transportation, drainage, street system, telephone system and water supply.

Emphasis was laid in discussion on T. Glenn Phillips' paper on "The Street System" on the necessity in zoning to find where traffic originates and goes to before designating through streets. Otherwise property would be harmed and owners would pay more than their share for non-used facilities.

H. Malcolm Pirnie brought out the new point of taking account in zoning of the necessity of conserving catchment areas for water supplies.

E. P. Goodrich in discussing J. R. Bibbins' paper on "Transportation" gave some interesting unit figures: An average office building houses one person per 100 sq.ft. of floor area. At closing time in New York 1,700 persons will issue from such a building per hour. In the average residence district one vehicle per day will come to each house. To rural stores one vehicle per 5 ft. frontage may be counted on. In residence districts one family may be counted on per 40x100 ft. lot. To serve them a small store of 25 ft. per 100 persons is necessary. Only one zoning ordinance in a hundred has a limit on the density of population.

Albert P. Allen in discussing his own paper on "The Telephone System" stated that development of a central station in a residence district one-half mile from the center of gravity of its users' residence costs the user 76c. per month and one-quarter mile, 26c. per month.

Paul Hansen's paper on "Drainage" indicated how zoning helps from all angles, design and financial.

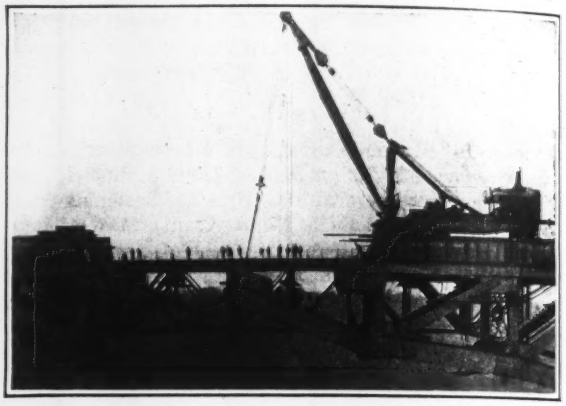
Closing 640-Ft. Michigan Central Arch Over Niagara Gorge

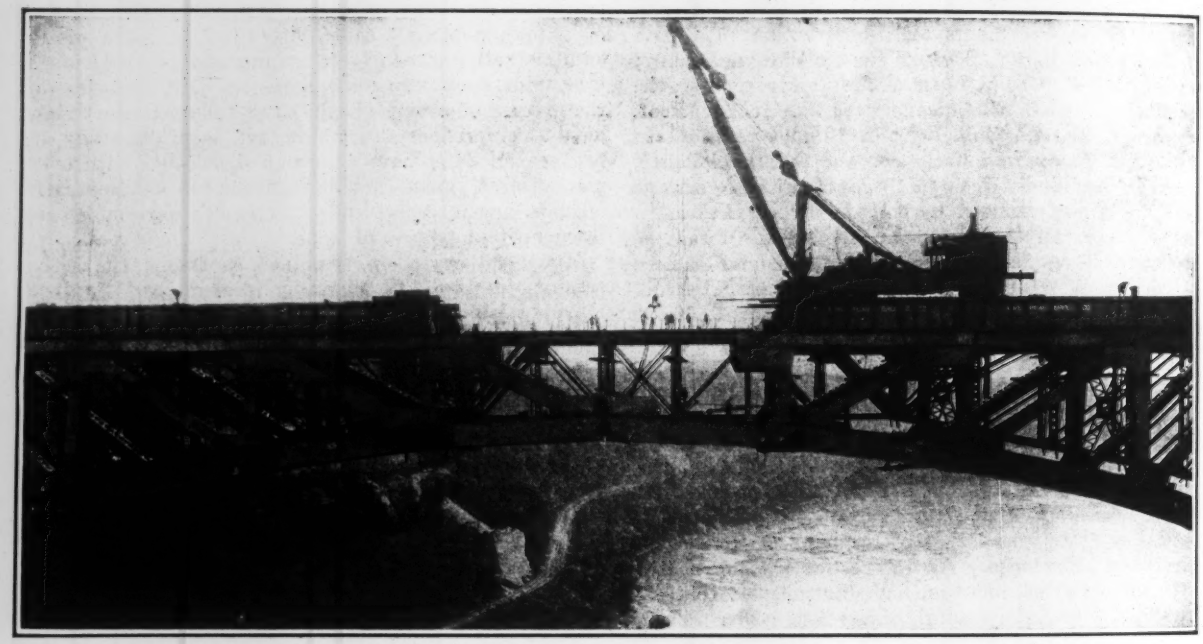
Cantilevered Halves Lowered to Junction by 39-In. Jacks in Backstays—Centralized Jacking Control Facilitates Operation

ON OCT. 11, six months after erection began, the large arch bridge of the Michigan Central R.R. over the Whirlpool Rapids gorge of Niagara River was brought to closure by lowering the two cantilever halves to junction on the crown pin of the bottom chord. For the first time in an operation of this kind, fully centralized control of the jacks was used. The new equipment and procedure proved entirely successful and accomplished the lowering uneventfully. The following account of the work is taken from detailed notes of H. Ibsen, who, as bridge engineer of the Michigan Central, directed the design and construction work for the railroad. Reference may be made to *Engineering News-Record* of March 1, 1923, p. 380, for an illustrated description of the design of the structure, which is a braced arch of 640-ft. span and 105-ft. rise carrying an independently framed floor with ballasted double-track roadway.

During the working season of 1923 the four heavy concrete skewback blocks were constructed, and four downward sloping tunnels were driven into the rock walls of the gorge, two on each bank, to receive anchors and backstay chains for erection (see *Engineering News-Record*, March 6, 1924, p. 398). The anchorage steel was set during January to March of the present year, and as soon as it was in place the tunnels were filled with concrete. It may be mentioned here that later, just before closure of the arch, under the full pull of the cantilevered halves, the anchor chains showed so small a stretch as to indicate that the backstay tension extended inward only about 20 ft. from the cliff face.

Superstructure erection was begun by the American Bridge Co., contractor for the steelwork, on April 8, 1924, with the placing of the plate-girder approach spans (American, 123 ft. long, changed from the originally planned 100 ft. because of foundation conditions; Canadian, 100 ft. long) whose outshore ends were first supported on temporary steel bents made of the second bent of the arch with extensions bolted on. Then the shoe castings and pins were placed on the skewback blocks, the lower castings being bedded on ⅛-in. sheet lead. The transverse strut between the shoes was bolted in place, and the end posts of the arch were set. After the approach girders were lowered to their seat on these posts and the temporary bent removed, the backstays were connected up between end post and anchorage. This work was completed on the American side by June 26 and on the Canadian side by Aug. 1.





FIGS. 1 AND 2—PLACING LAST MEMBERS OF MICHIGAN CENTRAL ARCH BEFORE LOWERING HALVES OF THE STRUCTURE TO CLOSURE

Old cantilever bridge in background will be removed after traffic is diverted to the arch bridge.

Cantilever erection of the arches proceeded on the respective sides from June 30 to Sept. 27 and from Aug. 1 to Oct. 8. On the latter date both halves of the structure had been completed to the crown, except for the last section of top chord, the center post, and the bracing and the floor of the last panel, which had to be left until after the arch was joined.

The measured distance between ends of bottom chord checked almost precisely with the computed distance of 11$\frac{31}{32}$ in. at normal temperature. Laterally the half arches were not precisely in line, the outer end of the American half being 2$\frac{1}{4}$ in. north of the Canadian half. This misalignment was due to the fact that in erecting the American half the members of the south truss were set first, which had a tendency to force the structure slightly to the north, while on the Canadian side the north truss members were set first and the structure worked to the south. After four panels were erected, the operation was reversed, but apparently this did not wholly correct the initial distortion, as the bracing is very stiff and was kept fully bolted as the work progressed. Only a small pressure was required to bring the two half arches into line at the center when making the junction on the crown pin, and it is expected that all effects will be eliminated when the bolts in the bracing are removed for riveting.

Equipment for Closure—Closing the gap between the ends of the completed half arches was accomplished by means of four 3,000-ton hydraulic jacks, one in each backstay. The jacks had been tested in the storage yard at the bridge site to 2,500 tons, which was about 25 per cent more than the load they had to take care of. Each jack was located at the center of its backstay, between two pairs of sliding plates, of which one pair was in fixed connection with the anchorage by way of the lower half of the backstay, while the other pair was connected to the end of the top chord by way of the upper half of the backstay. Two pins specially designed to bear on the jack base and plunger transferred the stress from the jack to the plates; the upper of these pins was fixed to the plates attached to the anchorage and passed through slotted holes in the plates attached to the end of the top chord, while the connection of the lower jacking pin was the reverse.

At the time the backstay was erected the slotted holes in one pair of sliding plates were filled out to pin bearing with $\frac{1}{2}$-in. shims, there being 28 shims in each plate, so that the jacking pin at this point transferred the backstay stress directly to the other sliding plate until the jack was put into operation. The jack became then a strut between the two jacking pins and first moved them sufficiently apart to release the bearing on the shims, which were then removed one by one while the plunger was retracted upward with the upper sliding plates, the lower pin and the shims, so that at no time was there more than a gap of $\frac{3}{8}$ in. between the fixed plate and the shims.

A flat car carried the boiler and pumping engine for operating the four jacks, together with control levers and water connections to the four pipe lines leading to the jacks. This car was moved out to the outer end of the floor on the American side and connections were made to the high-pressure pipes leading to the jacks. These pipes had $\frac{1}{4}$-in. bore and outside diameter of 1 in. The pump, which was specially designed for this job, is a double-acting steam-driven pump with four independent pump cylinders, corresponding to the four pipe lines leading to the jacks. Each pipe line was fitted with a mercury gage on the connection to the pump, which registered the pressure on each jack, and the control was so arranged that the jacks could be operated simultaneously or each separately as required. There was telephonic connection between the engineer having charge of the removal of the shims in the backstays at each end of the bridge and the engineer in charge of the control of the pump at the center of the bridge. The engineer at the center of the bridge also had a full view of the ends of each half span, so that he was in direct control of all the operations.

To guard against accident due to a pipe-line break, each jack was fitted with two check valves, one designed to close completely and the other having a $\frac{1}{32}$-in. opening designed to release the pressure gradually. This later was found too slow of operation and therefore was removed after the piping and connections had been tested out. The operating pressure was a little above 3,000 lb. per square inch. With this the 39-in. jack

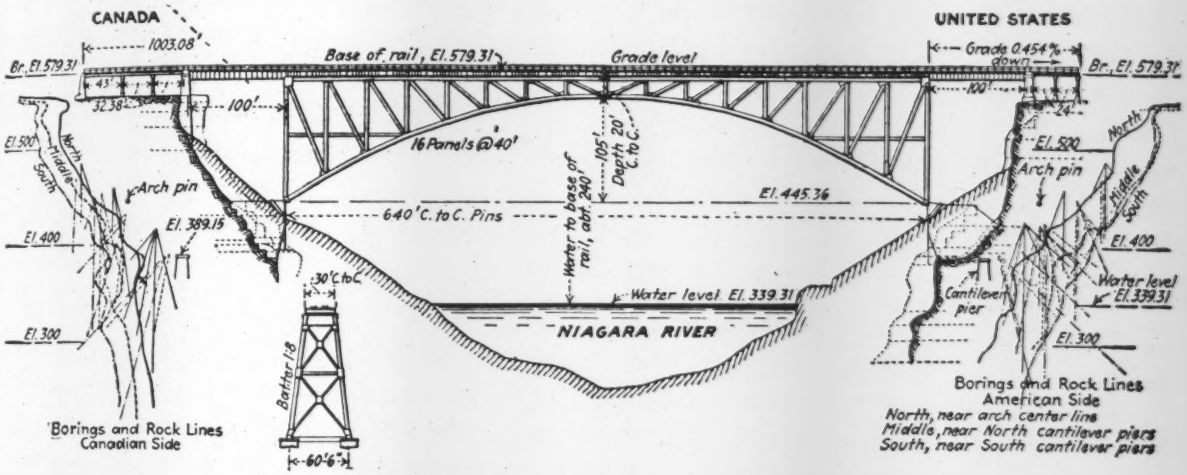


FIG. 3—DIMENSIONS OF NEW ARCH BRIDGE OVER NIAGARA GORGE

Approach span on American side subsequently lengthened to 123 ft. because of the necessity of removing fissured rock at top of cliff.

plunger gave a total pressure of 3,600,000 lb., equal to the pull in the backstay after the erection derrick car had been moved off the bridge.

Lowering the Half Arches—On Oct. 9, after testing the connections and pipe lines, the American side was tried out by taking out one shim, but on account of the small opening of the safety valve the half arch had moved only a fraction of an inch in an hour (4:30 p.m.). The safety valves were then removed and the lowering of the American half continued. By 5:30 the crown end had lowered 4½ in. and moved outward 2 in.; five shims had been removed. The pins supporting the jacks were then brought to a bearing on the shims for the night. On Oct. 10 lowering of the Canadian half began at 7 a.m., and in two hours four shims had been removed. The jacks on the American side were then put into operation and both halves of the arch were lowered at the same time until 11:30, when there was 1 in. clearance between the center pin and the pin hole at the crown of the arch. The operation of the jacks was then stopped and the ends of the trusses were lined up with little effort. As soon as this was done, the placing of the splice plates at the center joint of the bottom chord was started. These plates were very difficult to enter and work had not been finished by evening. On the following morning (Oct. 11) work was continued placing the splice plates at the center joint, bolting them to the Canadian half, and placing the bottom-chord bracing in the last panel of the American half, connecting it only at the inner panel point (B7). After slight delay due to a leak the final closing operation was started at 4 p.m. The two halves then moved together at a rate of ½ in. in six minutes. When the pins were bearing and the pressure had dropped to 2,100 lb. per square inch, the lowering operation was again stopped, holding the pressure on the jacks, while the lateral bracing was connected and the splice plates at the center point were being bolted up (1-in. bolts in the 1¼-in. holes) in the American side of the joint. By 5 o'clock this was finished and the slacking off of the jacks continued. By 5:05 the pressure on the jacks had dropped to 1,800 lb. per square inch and by 5:10 the pressure was zero and the structure had become selfsupporting as a three-hinged arch.

While the closing operation took considerable time the whole operation was satisfactory and movements and deflections followed the calculated movements closely.

Establishing Two-Hinged Condition—The center posts and the two center panels of the top chord of the arch truss and the lateral and sway bracing had been placed by Oct. 15. To change the arch from three-hinged to two-hinged a 7-in. screw 6 ft. long, fitted at each end with two nuts adapted to bear on diaphragms riveted to the top chords on each side of the center joint, was used. The closing temperature desired was 60 deg. F. This temperature being reached at 4 p.m. on Oct. 15, it was only necessary to screw the nuts up tight against the diaphragms and go ahead and drill the rivet holes in the blank connection between top chord and center post. These holes have now been drilled and the rivets have been partly driven and the floor has been erected on the center panels, so that the steelwork is practically complete, except for riveting. The floor has also been riveted, ready for waterproofing. The riveting of the bottom chord and the bracing remains to be done. With favorable weather the arch will be ready for traffic by the middle of November.

Geodetic Survey Issues Pamphlet on Magnetic Declination in Florida

By N. H. Heck
Commander, U. S. Coast and Geodetic Survey, Chief of Division of Terrestrial Magnetism, Washington, D. C.

TO MEET a growing demand for localized information concerning magnetic declination, the U. S. Coast and Geodetic Survey has recently completed a survey of Florida, the results of which are contained in a Department of Commerce Bulletin of the Survey, the serial number of which is 262.

While the Coast and Geodetic Survey does not use magnetic methods in any of its precise determinations of angle and distance in general survey work and is fully aware that magnetic surveying methods are subject to error, it realizes that they have been and are still being used in land surveying. Therefore, the Survey is anxious to give surveyors the benefit of the accumulated information. The publication for Florida is the second of the series, that for Arkansas having been the first.

The introduction to this pamphlet gives useful information for local surveyors. The tables of secular change, which are perhaps more in demand than any other class of information, are given by counties in order to eliminate interpolation.

Heretofore all publications have treated the country as a whole and as the work done each year appears in the annual publication, it has been necessary to meet requests for local information by special letters, and there has been no one publication which could be furnished to meet local demands. This situation is now being remedied by the publication of complete magnetic information by states, giving both tabular information and descriptions of stations, as well as showing distribution on an isogonic chart.

The magnetic survey of the United States, which was started in 1899, has been practically completed with a marked station at every county seat, with many repeat observations being recorded. Therefore, it is possible to furnish values of the declination and a description of the marked stations for practically every part of the United States. Thus, the error of the surveyor's compass and transit may be tested. A systematic inquiry into the present condition of the 3,700 marked stations in the United States is in progress, mainly through letters addressed to local surveyors, which have already brought in reports on about one-third of them. It is found that many of them have disappeared or are no longer available for use. Where the local authorities desire it, it is intended to replace lost stations as rapidly as circumstances will permit. This isogonic chart, which appears on a base map of the Geological Survey, is a useful aid in estimating the declination in places where no observations have been made.

Additional publications such as that having to do with Florida are in course of preparation and the necessary surveys are now being made in Missouri, California, North Carolina and Texas. It is planned to issue supplements from time to time in order to bring the information up to date, until new publications can be issued.

As an example of the appreciation of the need for such publications, the co-operation of the North Carolina Geological and Economic Survey has made it possible to have a recently occupied station at every county seat at the time the publication for that state is issued.

The pamphlet is compiled by W. N. McFarland.

Water-Supply Notes and Problems in New York and New England

Further Papers Before the Annual Convention of the New England Water Works Association—*Continued from p. 578*

Review of Some Floods and Droughts on New England Streams

By Caleb Mills Saville
Manager and Chief Engineer Water Department, Hartford, Conn.

During the summer and fall of 1923 drought conditions in Southern New England put many water departments on short service but on the Hartford drainage area both the rainfall and runoff for the entire year exceeded those of the two earlier years, the rainfall being 45.07 in. and the runoff 25.36 in. or 56.3 per cent in 1923.

Observations on the watersheds of Hartford and vicinity [reviewed in the paper] indicate (1) that frequent runoffs are from 50 to 60 sec.-ft. per square mile; (2) that flood discharges of 90 to 100 sec.-ft. per square mile may be expected occasionally, say once in 25 to 30 years; and (3) that 200 sec.-ft. may be looked for at rare intervals when combinations of ground conditions, stored snowfall, rising temperature and heavy precipitation occur.

It appears that there are two types of flood-producing storms to be considered under New England conditions: (1) Autumnal, occurring when the ground storage is depleted and the streams are low; and (2) vernal, due to warm rains on a snow- and ice-covered territory, the latter being the more severe of the two, even when the precipitation is lower, because they unlock frozen water collected during the preceding winter months.

* * *

How Water-Supply Improvements Have Reduced Typhoid Fever

By C. A. Holmquist
Director, Division of Sanitation, New York State Department of Health, Albany, N. Y.

The typhoid rate was 83 per cent lower for the five-year period 1918-22 than for the year 1900 in the registration area of the United States as it was in the earliar years, the comparative rates being 31.3 and 5.3 per 100,000. For New York State alone there was a reduction of 87.6 per cent between 1900 and the five-year average for 1919-23, the rates being 26.7 and 3.3. The rate for 1923 was 2..9 per 100,000. This decline has been largely due to filtration and chlorination and to state control of sewage disposal.

In New York State only 700,000 people were supplied with purified water in 1906 against 7,796,000 in 1922. From 1906 to 1922 the number of water purification plants increased from 18 to 176. Of 249 surface sources of supply, 98 are protected against contamination by rules and regulations of the State Department of Health. [Figures and curves showing the notable decline in typhoid following the introduction of filtration and chlorination at Albany, Binghamton, Cohoes and Niagara Falls are given in the paper.]

The accompanying table summarizes by sources and modes of treatment the water-supplies of New York State as of 1922.

SUMMARY OF WATER-SUPPLY DATA OF NEW YORK STATE, 1922

1. *Classification as to source*

Character of Source of Water Supplies	Number of Supplies	Number of Communities Served	Population Served
Surface water (*a*)	249	330	7,823,000
Ground water	215	270	1,066,000
Supplies derived partly from surface and partly from ground water sources (*b*)	89	91	293,000
Total (*c*)	553	691	9,182,000

2. *Classification as to Treatment*

Character of Treatment of Water Supplies	Number of Supplies	Number of Communities Served	Population Served
Treatment by chlorination only (*d*)	79	123	6,726,000
Mechanical filtration and chlorination	48	83	657,000
Slow sand filtration and chlorination	12	15	325,000
Mechanical filtration without chlorination (*e*)	20	22	44,900
Slow sand filtration without chlorination (*f*)	17	18	43,300
Total (*g*)	176	261	7,796,200

(*a*) Of the 249 surface water supplies in the State, 98 are protected from contamination by rules and regulations enacted by the State Department of Health.

(*b*) Although the New York City supply is derived partly from wells, it is listed under surface supplies, inasmuch as only a very small percentage of the total supply is from wells.

(*c*) Of the 553 supplies in the State, 336 are owned and operated by municipalities; 192 are owned and operated by water companies serving one community each and 25 are owned and operated by water companies serving two or more communities each.

(*d*) Include both liquid chlorine and hypochlorite plants.

(*e*) Of the 68 mechanical or rapid sand filters, 34 are of the gravity type and 34 of the pressure type and one supply has both a gravity and mechanical filtration plant.

(*f*) A few water supplies are provided with both slow sand and mechanical filters operated either in series or independently. In such cases they are counted under the type of filter predominating.

(*g*) Eighty-six per cent of population in State served by public water supplies, 73 per cent by treated water.

The estimated population of the State in 1922, based upon the average annual increase between the United States censuses of 1910 and 1920, was about 10,651,000.

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* * *

Shorter Abstracts

Sand-Spun Pipe—Because Walter Wood was unable to be present, C. R. Wood briefly outlined the manufacture of sand-spun cast-iron pipe, as being developed at the works of the American Cast Iron Pipe Co., Birmingham, Ala., jointly by that company, R. D. Wood & Co. and other cast-iron pipe makers. At present, 4- and 6-in. sand-spun pipe is being made commercially. The sizes are to be extended to 12-in. and eventually to 24-in. Cement lining, centrifugally placed, is supplied when desired. The new pipe, without cement lining, is being sold at slightly less rate per foot than ordinary cast-iron pipe, but it is likely that cement lining will make it cost more. C. M. Saville of Hartford, Conn., and F. A. Gifford, of Dedham, Mass., reported satisfactory results thus far as regards the ability of the cement lining to stand tapping and handling respectively.

Diesel Engines for Pumping—A program paper on a Diesel engine installation not materializing, F. A. Hayes, of the Hayes Machine Co., Boston, was called on for remarks. He recalled the introduction of oil engines in Massachusetts by the late Frederick Coffin, twenty-five years ago, as well as later installations, including the Diesel. He predicted the time when "you will use oil engines."

Selling—In "Some Aspects of Selling from the Manufacturer's and Purchaser's Viewpoint," by W. P. Mosteller, eastern sales manager, United States Cast Iron Pipe & Foundry Co., the author spoke of the advantages of having customers visit manufacturer's plants and learn for themselves some of the conditions governing the filling of orders. Mr. Mosteller also suggested the careful reading by purchasers of manufacturer's advertisements.

Luxuries Become Necessities—Under the title "Luxuries of Yesterday are the Necessities of To-day," C. C. Behney, Simplex Valve & Meter Co., Philadelphia, put master and district meters, automatic control devices and the like in the present-day necessity class.

Articulated Locomotives for Heavy Grades

On the 175-mile Mushkaf-Bolan section of the Northwestern Ry., India, the ruling grade is 4 per cent and the train load for freight engines of the 2:8:0 type is only 160 tons, so that the trains are handled by two to four locomotives. In order to improve these operating conditions the railway is to make comparative tests of two designs of articulated locomotives. The first of these, which is already in service, is an American-built Mallet engine of the 2:6:0:0:6:2 type, weighing about 122 gross tons, or 188 tons with tender. The second locomotive, now being built in England, is a Garrett engine of the 2:6:2:2:6:2 type, weighing about 166 tons but having no separate tender. Both engines are required to handle 300-ton trains on the long 4 per cent grades. The track is on the Indian standard gage of 5 ft. 6 in.

Novel Plan for Estuary Tunnel at Oakland, Calif.

Concrete Tube Sections 203 Ft. Long May Be Sunk in 68 Ft. of Water to Precast Foundations in Dredged Trench

PLANS have recently been completed for a vehicular tunnel to be built under the estuary separating Oakland and Alameda, Calif., the length between the portals to be 3,500 ft. and the total length including approaches 4,500 ft. The roadway is to be 25 ft. wide, including two electric railway tracks, and there will also be two 3-ft. sidewalks. Specifications invite bids on either of two designs, one being a precast reinforced-concrete tube and the other a tremie concrete structure with a steel tube similar to the subaqueous section of the Detroit and Harlem subways.

Construction plans have been worked out in some detail for the precast-tube method. The scheme in this case would be to cast the tube in 203-ft. sections on shore, bulkhead the ends and float the sections to place, where they would be sunk to position on concrete piers set to grade in a trench previously excavated by dredging. While being lowered the sections would be controlled by cables to winches on four or more barges which would have a combined lifting capacity sufficient to lift the tube sections in case exact placement was not obtained on first trial. After placing the sections, joints would be made tight by tremie concrete and the same method would be used to place a 2-ft. concrete slab under the tube, after which the trench would be backfilled.

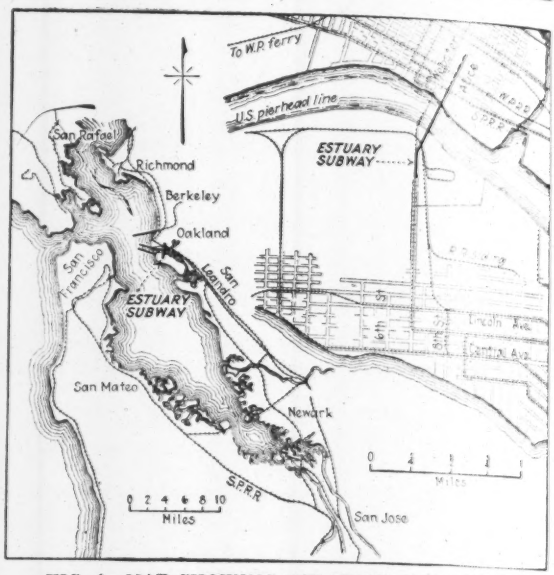


FIG. 1—MAP SHOWING RELATION OF CROSSING TO BAY CITIES

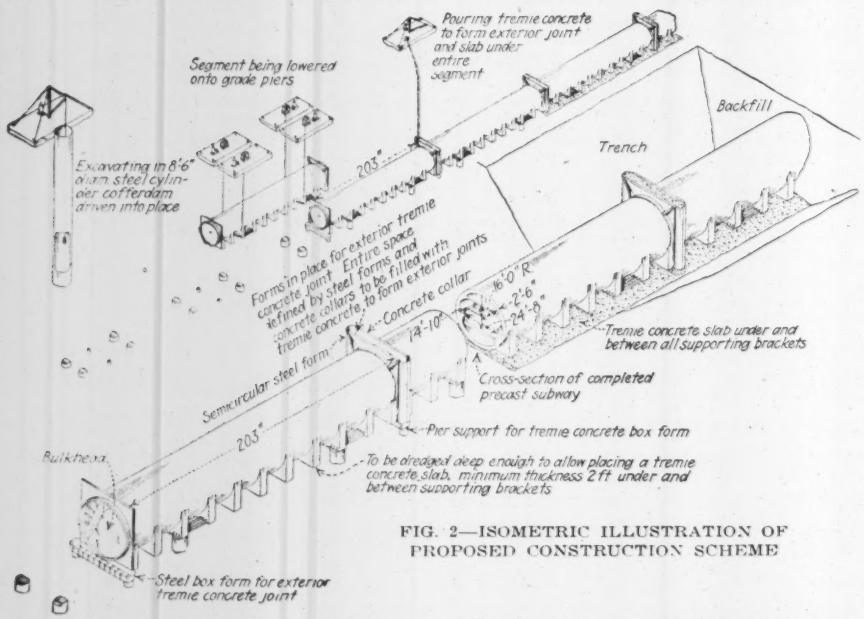

Pouring tremie concrete to form exterior joint and slab under entire segment
Segment being lowered onto grade piers
Backfill
Trench
Excavating in 8'6" diam. steel cylinder cofferdam driven into place
203'
Forms in place for exterior tremie concrete joint. Entire space left by steel forms and tremie collars to be filled with tremie concrete to form exterior joints
Concrete collar
16'0" R
2'6"
24'8"
14'10"
Tremie concrete slab under and between all supporting brackets
Semicircular steel form
Cross-section of completed precast subway
Pier support for tremie concrete box form
203'
Bulkhead
To be dredged deep enough to allow placing a tremie concrete slab, minimum thickness 2 ft. under and between supporting brackets
Steel box form for exterior tremie concrete joint

FIG. 2—ISOMETRIC ILLUSTRATION OF PROPOSED CONSTRUCTION SCHEME

For about four-fifths of its length the tube will rest on "tough clay" and the remaining one-fifth, on the Alameda end of the tube, in mud 100 ft. deep. In this mud, excavation of 20 to 25 ft. is to be made, and this excavation is to have side slopes of 1 to 3. In this mud section the tube is to be supported on piles.

Such excavation as is necessary on the four-fifths of the length which is in harder material will be made in the clay itself. This clay, classed by those who made the investigations as the same material as would be called hardpan in dry excavation, is found to stand under water on almost vertical slopes. However, in excavating in this material the plan will be to give the sides of the trench a slope of 1 to 1.

Except for the inconsiderable amount of sand and soft mud overburden at the shore line on the Oakland side, the soft material, as described above, is confined to the Alameda end of the tube, beginning at about the pierhead line and extending from that point inshore some five or six hundred feet.

The crossing of this waterway has been under consideration for a long time. Agitation for the removal of two low-level swing-bridges near the crossing now proposed dates back to 1908. One of these structures was a vehicular and street-car bridge and the other was used exclusively by the Southern Pacific R.R. Shipping interests farther up the channel objected to the danger and delay of getting vessels past these bridges, and their removal was finally ordered by the War Department in 1916. The objection to these structures cited by the War Department was that they constituted "unreasonable obstruction to the free navigation of the estuary on account of insufficient width of the draw opening, insufficient clearance above water surface under bridge, and the location of the piers at too close intervals under the approaches to the draw span."

Plans for a single bascule bridge to take the place of both bridges were then prepared and an apportionment of the cost of $1,800,000 between county and railroad was agreed upon. The removal order, however,

was suspended during the war and when it was later renewed the cost of the bridge had increased to $3,000,000. The railroad company then decided to abandon a crossing at this point and dropped out of the negotiation. (The removal of the railroad swing-bridge was described in *Engineering News-Record*, Jan. 10, 1924, p. 91.)

Early in 1923 an investigation was made by George A. Posey, county engineer, to determine the feasibility of building a tunnel instead of a bridge. Traffic counts made at this time and compared with a traffic survey made in 1912 showed the following rapid increases in motors, street cars and ships:

	1912	1923
Average number of autos crossing bridge during rush hour (5 to 6 p.m.)	67	1,005
Average number of pedestrians crossing bridge during rush hour (5 to 6 p.m.)	220	201
Number of street cars per day	160	260
Number of vessels passing through bridge draw per year	13,000	18,000

Based on Mr. Posey's recommendations and estimates, on May 8, 1923, Alameda county approved by a 4 to 1 vote a $4,500,000 bond issue for the construction of a vehicular tunnel at this point. According to the plans on which bids are now being invited, the tube will provide for vehicular and street car traffic but not the steam railway. If the bids received are satisfactory it is believed that the crossing can be built and ready for service by the end of 1926.

George A. Posey is chief engineer of the subway project. William H. Burr and Charles Derleth are consultants, and the late Clifford M. Holland was a consultant on the project.

Italian Railway Construction

The Italian Government has made an appropriation, in addition to expenditures authorized in the budget, amounting to 100,000,000 lire for the construction of a new direct railway between Florence and Bologna, cable advices to the Department of Commerce advise.

Car-Ferry for an African Railway

TO CARRY an extension of the Nigerian Eastern Ry. across Benue River, 2,000 ft. wide, a car-ferry has been established which has the unusual feature of steel construction for the traveling cradles which connect the approach tracks with the transfer boats at different stages of the river. These cradles are of similar type to the timber cradles of the car-ferries on the Mississippi River.

The cradle length is reduced about 50 per cent by forming the deck with an upward grade of 3.3 per cent to the steamer, instead of making it horizontal. The incline approach on the river bank has a descending grade of 3.3 per cent and its upper portion has a concrete trench for the approach track of 3 ft. 6 in. gage and the cradle track of 10 ft. 8 in. gage. On the lower part of the incline the tracks are on a fill of rubble stone. The range of water level of the river at this point is about 24 ft.

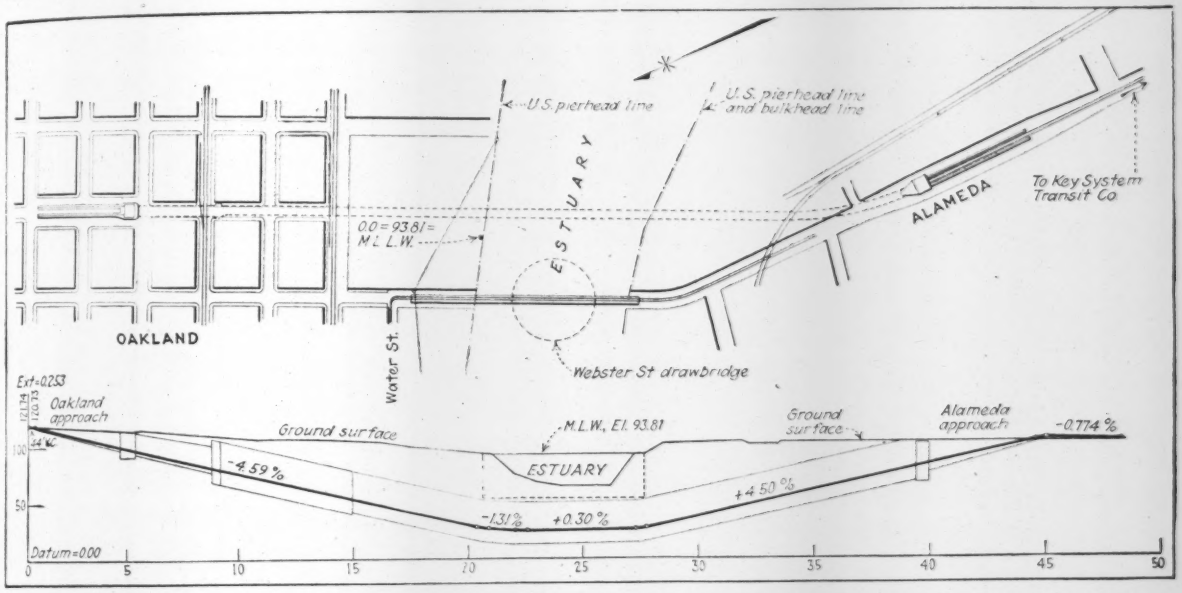


FIG. 3—LOCATION MAP AND PROFILE OF PROPOSED ESTUARY TUNNEL BETWEEN OAKLAND AND ALAMEDA

Two 217-ft. steel trusses connected by cross-bracing and carrying a 14-ft. solid deck of steel troughs form the main part of the cradle, which is mounted on 24 cast-steel wheels spaced 16 ft. c. to c. At the outer end the deck flares to a width of 22 ft. to provide for turn-outs connecting with the five tracks on the steamer and has a hinged apron to connect the cradle tracks with those of the steamer. At the shore end is an apron with manganese-steel feather rails connecting with the fixed track on the incline. Beyond the lower end of the cradle extends a slipper which rides on the track by means of small wheels and carries wood blocks shaped to fit the keel of the steamer.

Operation of the cradle is effected by hand hoists with cables led through snatch blocks attached to steel posts set 60 ft. apart in the middle of the track. To these posts the cradle is moored at any desired position. These cradles, with the approach inclines and other features, were designed by Coode, Fitzmaurice, Wilson & Mitchell, of London, as consulting engineers for the Nigerian government.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Ontario Studies Gravel Road Corrugations

Sir—In your editorial, "Road Corrugations Not Explained" appearing in the issue of Oct. 16, 1924, you question George E. Ladd's reasons for the formation of corrugations because similar traffic should produce corrugations in all earth or gravel roads and you further add, "It would be valuable to know under what conditions corrugations do *not* occur."

Mr. Ladd stated that the vertical oscillation of automobiles caused the corrugations. Experience on Ontario's gravel roads with traffic from 100 to 1,500 daily is that corrugations do not form over the entire length of a road subjected to the same traffic but they may form on a section of road where plastic subsoil conditions and the thinness of the gravel crust give favorable ground in which the traffic can produce corrugations. Bad dragging on a thinly graveled road may produce ripples but it is the traffic that is the cause of all corrugation troubles; and, whereas 1,500 cars daily on a gravel road may cause a few corrugations, the same traffic on an earth road would not produce corrugations at all but would make that road look like a plowed field. Corrugations would seem to be the initial indication of failure of a gravel road to be followed later by pits, holes and ruts and Mr. Ladd's reasons for the cause of the corrugations are logical.

On 95 per cent of Ontario's 1,000 miles of graveled provincial highway under the above traffic and on clay, sand, loam and muskeg subsoil corrugations have not occurred where drainage by tile and open ditch was provided, where the thickness of gravel was over six inches and where dragging and the application of fresh gravel were carefully and promptly attended to.

These maintenance methods will assist in preventing corrugations and hold the road in smooth surface until scarifying and reshaping are necessary.

Being very interested in Mr. Ladd's article I would be pleased to hear the views of other highway engineers on this aspect of gravel road maintenance.

GEORGE HOGARTH,
Chief Engineer, Department of Public Highways, Ontario.

Toronto, Ont.,
Oct. 23, 1924.

Sand as a Snow-Removal Possibility

Sir—Noting in your issue of Oct. 2, p. 550, the article on "Snow Removal on Fall River Road Across Continental Divide," I am reminded that many years ago I spent a winter under the Arctic Circle in Europe and in the spring observed the peasants sprinkling sand on the snow which was of a minimum depth of 7 or 8 ft. In a surprisingly short time the snow was gone over the areas so sprinkled and the little fields were being worked in neatly-formed excavations with 3 or 4 ft. of snow all about.

What happened, of course, was that even in freezing weather the sun's rays raised the temperature of the particles of sand above the freezing point and the adjacent snow was melted and on cloudy days, when the air temperature was above freezing, heat was absorbed from the air and the melting of the snow was greatly accelerated.

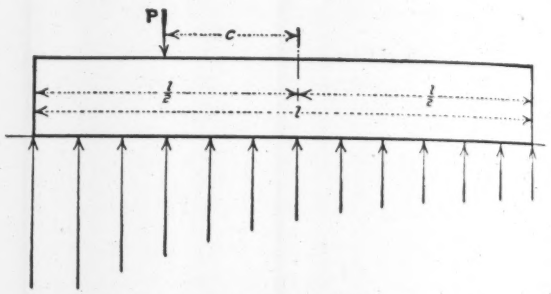
Under a Colorado sun in May and June this process should show excellent results. It would seem that the sand should be clean, sharp and coarse; that it should be sprinkled as early as thawing begins under the direct rays of the sun, and probably over a 60-ft. strip to insure all possible sunlight even at the bottom of the trench, for trench there soon would be. After a fresh fall of snow fresh sand would of coarse be sprinkled. That this process will remove all the snow from the road long in advance of the time when it would otherwise melt, there can be little question. Whether the fresh snowfalls, lack of sunlight and low temperatures would so retard the action as to make it impracticable for the purpose cannot be judged from the information given in the article. As the cost would be trifling and no loss or delay possible it would seem to me that the materials for an interesting experiment are at hand.

ARTHUR O'BRIEN,
Consulting Engineer.

Utica, New York.
October 6.

Problem in Eccentric Loading on Earth

Sir — The adjoined diagram illustrates a problem in bearing pressures under eccentric loads of which I have not been able to find full treatment anywhere. If this is a problem suitable for discussion in your columns, I would



HOW DO REACTION PRESSURES VARY?

greatly appreciate getting the advice of some of your readers on it.

A rigid beam rests on a smooth, uniform ground surface. It carries a concentrated load offset from the middle point of its length. What is the variation of pressure of the beam upon the ground? The maximum unit-pressure is assumed to be within the bearing value of the ground.

PAUL BURKE,
Chief Engineer, Northwest Engineering Co.

Green Bay, Wis.,
Sept. 17, 1924.

Control of Storm-Water Flow to Sewers in the City of The Hague, Holland

Sir—I read with much interest in *Engineering News-Record* of Sept. 11, p. 409, the editorial note on "Storm-Water Sewer Limits." You are quite right in saying that "storm sewers, large enough to carry the heaviest downpours, would bankrupt a city." At the end of the note this question is asked: "How many and what cities keep records that enable their engineers to establish a policy in this matter or, if one has been established, to check its soundness? And what is or should be the policy?"

In the city of The Hague, Holland, with 400,000 inhabitants, 250 miles of combined storm and sanitary sewers, and a maximum recorded rainfall of 2.2 in. in 60 minutes, we follow this policy: We permit no direct connections designed to admit drainage from any part of a building below the street level. Connections are permitted from all floors of the house higher than street level, including those taking rainwater from the roofs, gutters, etc. We advise the use of a very small electrically-driven pump to lift for discharge into the sewer all *the water collected below street level.* The city authorities limit the size of the main sewers in the streets. Even when the sewers are filled to the brim, neither the property owners nor the city suffer damage.

F. C. J. VAN DEN STEEN VAN OMMEREN,
Sub-director of Town Works.

The Hague,
Oct. 10, 1924.

[This is interesting testimony as to the control of the flow of storm-water from buildings to sewers, back flows from sewers to buildings and the fact that a limit (unstated in the letter) is placed on the size of street sewers, but it throws no light on the flooding of streets and lots by excessive rainfalls and possible damages therefrom.—EDITOR.]

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Special Franchises in New York City have been tentatively valued for 1925 taxation purposes at $491,200,000 by the New York State Tax Commission. The valuation for Buffalo is $36,300,000.

Improved Railway Facilities to cost about $3,000,000 are to be built in the city of Edmonton, Alberta, according to an agreement which has been made between the city and the Canadian National Rys.

A Major Street Traffic Plan for Los Angeles, Calif., will be submitted to the voters on Nov. 4 and also a bond issue of $5,000,000 to meet the city's share in the cost of the first unit in case the plan is adopted.

The International Association of Street Sanitation Officials will hold its next annual conference in Chicago at Hotel LaSalle Jan. 5 and 6. A. M. Anderson, 10 S. LaSalle St., Chicago, is secretary of the association.

Work on Mobile's New $10,000,000 port project has been started. The first work includes clearing right-of-way and making a new fill for the Louisville & Nashville track alterations. The work is to be done by the state of Alabama under the direction of Gen. William L. Sibert, chairman and chief engineer of the State Dock Commission.

The Construction Division Association, composed of those who served the government in this branch of the War Department during the World War will hold its next annual convention in Washington Jan. 16-18. Officers of the association are: Col. Don. H. Sawyer, president; Col. F. E. Lamphere, vice-president; Major Ralph H. Case, secretary; and Col. A. A. O'Brien, treasurer.

The City Manager Plan of government at Cleveland, Ohio, was virtually upheld by the U. S. Supreme Court on Oct. 27, as it had been previously by the courts of Ohio. The latest decision was based on lack of jurisdiction. The suit was brought by a taxpayer who claimed that the submission of the manager plan to the voters for adoption was a violation of state laws and the federal constitution.

After a Long Deadlock Union City has been chosen as the name for the consolidated towns of West Hoboken and Union Hill, N. J., the only two Hudson County towns that accepted a consolidation enabling act passed by the last legislature. Choice from among the various optional plans of municipal government permitted by New Jersey statutes will be made after the November election. The joint population of the two towns by the census of 1920 was 60,725.

Railway Proposed Across Florida

Plans for the construction of a railway across the Everglades in Florida, from Miami to Fort Myers, are reported to have been announced by Cornelius Vanderbilt, Jr., vice-president of the Florida Navigation & Railroad Co. The railroad would furnish transportation facilities for the farms which are being taken up in the sections of the Everglades which have been reclaimed by the construction of drainage canals.

Engineers' Club Approves Bonds for Sanitary District

Plans for financing the Springfield Sanitary District have been approved by the Engineers' Club of Springfield, Ill., on recommendation of a committee headed by J. Paul Clayton. A bond issue of $1,500,000 for a five-year construction program will be submitted for approval at the election on Nov. 4. The project, for which Pearse, Greeley & Hansen, Chicago, are engineers, was described in *Engineering News-Record*, June 5. The plan includes two intercepting sewers, two pumping stations, an activated-sludge plant to treat sewage up to 25 times the dry-weather flow, with settlement and chlorine disinfection for storm overflow in excess of the rate stated. The fully-treated sewage will be discharged into the Sangamon River below a proposed large water-supply reservoir but the settled and disinfected storm overflow will go into the reservoir.

Last Length of Pipe on Tulsa Water-Supply Project Laid

The last length of concrete pipe on Tulsa's (Oklahoma) new Spavinaw water-supply project was laid on Oct. 19, marking the completion of a $7,500,000 work in almost exactly two years' time from the date of letting of contracts. Particular credit is due the Water Commission, for over 50 per cent of the manufacture and laying of the concrete pipe was completed in the last nine months, under the direction of their engineer, W. R. Holway of Tulsa.

Interesting to engineers is the fact that the contractor's superintendents and foremen were entirely replaced by the engineering organization, who carried the work to a successful completion. One of the most difficult parts of their work was the crossing of various rivers and streams, and it was on the banks of Grand River, the most troublesome of these rivers, that the last pipe was laid.

On Nov. 17, President Coolidge will press a button in Washington and the city of Tulsa, celebrating its possession of one of the best water supplies in the Southwest, will see clear, cold, mountain water flow into her mains.

Clifford M. Holland, Tunnel Engineer, Dies

Was Chief of New York Vehicular Tube Project Under Hudson River—Helped Build Subways

On the eve of the "holing through" of the vehicular tunnel under the Hudson River between New York and Jersey City, marking the final stages in the construction of the 29½-ft. diameter subaqueous twin tubes to which he had devoted his energies, as chief engineer, for the last five years, Clifford M. Holland died Oct. 27 in Battle Creek, Mich., where he had gone three weeks ago to recover from a nervous breakdown. He was 41 years old and had served the city and the state of New York continuously for 18 years in designing and constructing tunnels for New York city's rapid transit subway system. It is said of him that he spent more time underground, particularly in compressed air, than any other civil engineer on similar work. The resolution of the New York-New Jersey Bridge & Tunnel Commissions granting him a month's leave of absence in September testified to "his continuous devotion, night and day, during the past five years" to the project of which he was the engineering head.

Starts on New York Subways

Clifford M. Holland was born in Somerset, Mass., in 1883, and after graduation from Harvard University, with both an A. B. and a civil engineering degree in 1906, he went to New York as assistant engineer with the Rapid Transit (later the Public Service) Commission, which was then engaged on the construction of New York's subways. He remained continuously on the city's subway and tunnel work until his appointment in 1919 as chief engineer of the New York-New Jersey Bridge & Tunnel Commission, which was created to construct the great vehicular tunnel under the Hudson. Tunneling had a peculiar fascination for him and after several years' experience on the river tubes of the subway, he told his friends that he had found the kind of engineering work that he really liked and intended to specialize in it.

This early resolution was realized by his subsequent long period of service with the New York Public Service Commission where successive promo-

(Continued on p. 726)

McGovern Awarded Subway Work in Philadelphia

Section of Broad St. Work From Clearfield to Courtland St. Let for $13,485,414

The Philadelphia Department of City Transit has awarded to Patrick McGovern, Inc., New York, a contract for construction of the Broad St. subway between Clearfield St. and Courtland St. The section comprises approximately 8,591 lineal feet of four-track subway. It is of the same type of construction and will connect with the subway work now under construction under contracts awarded in July. The contract price for the new work is $13,485,414.

The new contract is designated as Contract 106. Proposals were received for the entire work, and also for the work divided into two approximately equal sections, designated respectively as 106A and 106B. The 106A section extended from Clearfield to Butler St. and the 106B section from Butler to Courtland St. Four bids were received for the entire work, as follows:

Patrick McGovern, $13,485,414; the Arundel Corporation, Baltimore, Md., $14,906,275; Rodgers & Hagerty, New York, $15,055,000; and Booth & Flinn, $14,426,910.

Patrick McGovern, Inc., and Frederick Snare Corporation bid on the work on proposals for the separate sections, the proposal of Patrick McGovern being in addition to his proposal for the entire work. The aggregate amounts of the bids thus received are as follows:

	Cont. 106A	Cont. 106B
Patrick McGovern, Inc.	$7,466,490	$6,268,714
Frederick Snare Corp.	7,990,610	7,347,660

The successful bidder's figures for the entire work represent a saving of $249,790 over his figures for the two sections as separate contracts.

Hoover Calls National Conference on Traffic Accidents

Secretary of Commerce Hoover has called a national conference on state and highway safety for Dec. 15-17. Request for this conference, for better organizing and co-ordinating activities to reduce highway traffic accidents, was made six months ago by a number of national associations interested in this field. Consequent to that request, eight special committees on different importants phases of the problems were appointed, representatives being chosen from all parts of the country and embracing police officials, highway and motor-vehicle commissioners, insurance companies, safety councils, chambers of commerce, labor unions, automobile associations, and various other national and special groups. These committees have a membership of 186 persons and cover the following subjects: Statistics, traffic control, construction and engineering, city planning and zoning, insurance, education, motor vehicle and public relations.

Committee reports will be ready for reading at the December conference.

Los Angeles Honors Mulholland, Forty-Six Years With City

At a meeting of the Board of Public Service Commissioners on Sept. 23, William Mulholland, chief engineer of the Los Angeles Bureau of Water Works and Supply, was presented with a service emblem which signified that he had given more than twenty-five years service to the city's water system. The

WILLIAM MULHOLLAND RECEIVES SERVICE BUTTON

presentation was made by President R. F. Del Valle of the Board of Public Service Commissioners. Presentation of the emblem to Mr. Mulholland was made a special occasion at the meeting of the board for the reason that Mr. Mulholland had been unable to attend the general service pin presentation ceremonies conducted at Trinity Auditorium. On this occasion six classes of service emblems were presented to employees, namely, (1) to those who had served over twenty-five years, (2) to those who had served over twenty years, (3) to those who had served over fifteen years, (4) to those who had served over ten years, (5) to those who had served over five years, and (6) to those who had served over one year.

Mr. Mulholland started in the employ of the water system serving Los Angeles in 1878, and has been constantly identified with the Los Angeles water system since that time, or over a period of forty-six years. In 1886 Mr. Mulholland was made chief engineer of the City Water Co., and in 1902 when the city purchased this system and took it over as a municipal enterprise, Mr. Mulholland was retained as chief engineer. Mr. Mulholland has filled the position of chief engineer for more than thirty-eight years.

Bond Issue Enabling Act Declared Invalid

The Dauphin (Pa.) County Court has found unconstitutional the enabling act which made available the $50,000,000 for highway purposes in Pennsylvania. The decision was the result of a friendly suit to determine whether the enabling act was constitutional. The Dauphin County decision will be appealed to the Supreme Court and if that body upholds the lower court, the only thing necessary will be for the legislature to pass a resolution when it convenes Jan. 19, 1925. In the meantime other provisions have been made for financing the construction program.

Sewer and Flood-Protection Fund Voted for Cairo, Ill.

As part of a program for protecting the city of Cairo, Ill., from floods and filling its low-lying sections to a new grade line, as outlined in *Engineering News-Record*, April 5, 1923, p. 614, the city has recently voted $150,000 toward the construction of a large intercepting sewer, the rehabilitation of the four pumping stations and the carrying out of some levee protection work. The pump work will be done this winter but the sewer may be held until next spring. The general project was planned by C. E. Smith & Co., consulting engineers, St. Louis, Mo., and the work is in charge of George F. Dewey, city engineer.

Activated Sludge, Ltd., Sues Chicago Sanitary District

Suit has been filed in the U. S. District Court, Northern District of Illinois, by Activated Sludge, Ltd., of London against the Sanitary District of Chicago for infringement of process and apparatus patents. The suit is brought in the name of Edward C. Guthard, a resident of Chicago who is licensee for Illinois, Michigan, Indiana and Wisconsin.

The patents said to be infringed are those taken out by Walter Jones, of the English firm of Jones & Atwater, construction engineers, who sold the rights to Activated Sludge, Ltd. The six U. S. Patent Office numbers in the bill named are as follows: 1,247,540; 1,247,542; 15,140 reissue; 1,282,587; 1,286,017 and 1,341,561.

The Sanitary District has not as yet filed answer.

Council of State Engineering Examiners Meets Nov. 10-11

The annual meeting of the National Council of State Boards of Engineering Examiners is to be held at Washington, D. C., Nov. 10-11. Headquarters will be at the Washington Hotel. The principal topics to be considered include (1) changes in or additions to the articles of agreement, (2) what steps can and should be taken to insure the enforcement of engineers' registration laws, (3) should the association join with the National Council of Architectural Registration Boards, or reach some agreement with that Council so that reciprocal registration between architects and engineers will be recognized in non-licensed states, (4) should it be made easy and inexpensive for well-qualified engineers to obtain reciprocal registration, and, if so, how, and (5) what new lines of work should the Council take up during the ensuing year.

Aside from business sessions the morning and the afternoon of Nov. 10 and during the morning of Nov. 11, visits will be made to the White House and the United States Mint. An informal dinner will be held the night of Nov. 10.

T. Keith Legaré is secretary-treasurer of the council.

Sanitary Engineers Meet With A.P.H.A.

Environmental Factors of Sewage, Water, Garbage and Air Hold Attention for Four Sessions

Engineering News-Record Staff Report

Interest to the engineer attending the Detroit meeting of the American Public Health Association Oct. 20-23 centered around the four sessions of the sanitary engineering section, one of which was a joint meeting with the sanitary engineering division of the American Society of Civil Engineers. In the election of Dr. Henry F. Vaughan, health commissioner of Detroit, as president, the association has for the second time in 52 years chosen an engineer. The engineering profession has not been so honored since 1913 when the late Dr. Rudolph Hering was chosen president. Dr. E. O. Jordan, Robert Spurr Weston and Langdon Pearse (new chairman, sanitary section), the newly elected non-medical members of the governing council, with Dr. Vaughan, George W. Fuller, and C.-E. A. Winslow, holdover members, make quite a sprinkling of engineers and of those closely associated with sanitary engineering in the inner councils of the association.

In honor of the late Prof. W. T. Sedgwick, a medal is to be presented to young men for special achievements in public health work.

Papers and Reports

In the five papers and ten reports of the sanitary engineering section different phases of sewerage and sewage disposal had five places on the program, water four, resorts two, mosquito control two and refuse and air one each.

Water — Good horse sense seems finally to be prevailing in the working out of the new treasury standards for water supply for common carriers; history, treatment and laboratory control factors all are given weight. The proposed standards, which have been published for some time, are now in the hands of an appraisal committee.

George W. Fuller, in his review of water supply and purification, referred to nine high spots during the year: (1) An injunction in Pennsylvania was [quite recently] upheld by the State Supreme Court restraining mine owners from polluting a reservoir with acid waters; (2) iodine application to the water supply of Rochester, N. Y., is continued and has led to numerous controversial discussions; (3) many large water purification programs have proceeded and plants at Detroit, Omaha, Sacramento, Memphis and Richmond have gone into service; (4) the study of continuous cleaning of sedimentation basins by mechanical means has been expedited because of the high turbidities on the Missouri River; (5) interest has been revived in filter sandgrain study due to the announcement showing an unsuspected biological activity associated with clogging (see *Engineering News-Record*, March 27, p. 516); (6) water softening is on the increase; (7) an increased responsibility has arisen on the part of water departments to deliver a water which will not pick up objectionable material from the distribution system; (8) new aeration methods have been devised; and (9) the new treasury standard is still under discussion.

Better water for vessels on the Great Lakes is being obtained through better designs, which now must be submitted to the U. S. Public Health Service, by elimination of cross-connections on the boats by rearrangement of water facilities at docks. Joel I. Connelly, U. S. Public Health Service, gave the details in a paper written in conjunction with A. E. Gorman, now sanitary engineer in charge of chlorination of the Chicago water supply. Canada is co-operating, so H. W. Ferguson in charge of a similar service for the Dominion stated, and vessel owners are gradually being forced to comply with the regulations.

Certification and tagging of safe wells along the highways came out as a growing practice in Ohio, Pennsylvania, Illinois and Michigan in the discussion of the paper on "Resort Sanitation" by John M. Helper, assistant sanitary engineer, Michigan State Board of Health. Michigan is continuing the motorized laboratory control noted in *Engineering News-Record*, Sept. 14, 1922, p. 430.

Gas formation in broth and subsequent failure to identify B. Coli has caused water laboratory workers so much trouble that Jack J. Hinman's complete paper on "Differentiation in the Colon Group and Its Significance in Water Purification" will be welcome.

Sewage—An evaluation of the various methods and tests in sewage analysis was outlined by Dr. F. W. Mohlman, chemist, Sanitary District of Chicago. Pitfalls were pointed out in carrying out the biochemical oxygen demand test by the dilution method. Oxygen demand in Chicago has been determined as 0.22 lb. per capita daily. From this figure and the dissolved oxygen the oxygen balance is determined.

Progress in sludge utilization as a fertilizer will be rapid in the Middle West this coming year due to the plants going into service at Milwaukee and Indianapolis. Tests, said Langdon Pearse in the report of the committee on the subject, indicate gratifying results and a growing demand for the fertilizer. Outstanding developments include the abandonment of the Maclachlan process at Pasadena, the continued use of Oliver presses and development at Chicago of a single hydraulic direct-squeeze bag press by Berrigan. This committee and one on definitions of sewerage terms headed by John F. Skinner, Rochester, hope to bring in final reports next year.

Air—George A. Soper, chairman of the committee on air, wanted the association to underwrite publication of a book containing a résumé of available data. It was pointed out that the association had no such policy, but the committee was authorized to get out a comprehensive report.

Garbage—Whether to get out model incinerator specifications was discussed fully following a reading of the opinions of fourteen engineers whom the chairman of the garbage committee, M. N. Baker, associate editor, *Engineering News-Record* had induced to contribute to a symposium on the subject. The consensus of opinion indicated such a lack of data and poor operation of existing plants that presentation of principles only seems feasible. The committee was asked to continue in the light of the discussion.

Educational—Public health training in the ten schools giving degrees in sanitary engineering takes but 0.4 per cent of the whole course. Together with sanitary engineering subjects, such as water supply, sewage and refuse, the percentage is but 10 per cent. Abel Wolman at a dinner conference on the education of sanitarians gave the above figures which were obtained by the U. S. Public Health Service. A plea was made for more time, utilizing the time on additional environmental health factors, such as housing, food handling, insect eradication, industrial plant sanitation, vital statistics, science of epidemiology, physiology and anatomy.

In a later address at a general meeting Mr. Wolman spoke along similar lines in his paper on the "Value in the Control of Environment." Not all typhoid, as many health officers seem to think, comes from lettuce salad. Though typhoid averages only 8 per 100,000 in the registration area there are hundreds of smaller cities with high rates which have a water supply increasingly polluted. More complete methods of treatment are necessary and higher grade operators are essential.

Officers of the sanitary engineering section for the coming year are as follows: Langdon Pearse, chairman; Abel Wolman vice-chairman, and George W. Simons, Jr., secretary.

Ohio River Bridge Proposed for Portsmouth, Ohio

With the backing of the Chamber of Commerce of Portsmouth, Ohio, the Portsmouth-Fullerton Bridge Co. has been organized and has sold stock for the construction of a bridge over the Ohio River, at a cost of about $750,000. The engineer has not yet been appointed. Simon Labold, First National Bank, is president of the company; Gilbert S. Monroe, Ohio Valley Bank, is vice-president and Adam Frick is secretary and treasurer.

Engineer-Health Officer Elected President A.P.H.A.

Dr. Henry F. Vaughan, commissioner of health of Detroit since 1918, has been elected president of the American Public Health Asssociation. Dr. Vaughan is the second engineer and the youngest man ever elected to the office. He was born in Detroit in 1889 and took degrees of B. S., M. S. and D. P. H. at the University of Michigan in 1912, 1913 and 1916. From 1913 to 1917 he was engaged in sanitary engineering and public health work. From Dec. 12, 1917, to Jan. 28, 1919, he was in war service as commanding captain U. S. Sanitary Corps, at Camp Upton, N. Y., and Camp Wheeler, Ga., and as member of the Pneumonia Commission. He is joint author with his father, Dr. Victor C. Vaughan, and George T. Palmer of a recent three-volume work on "Epidemiology and Public Health." He is also head of the editorial board of the American Journal of Public Health.

Defense Construction Plans Discussed at Washington

Committee Appointed To Formulate Program for More Extended Conference in 1925

Washington Correspondence

A conference called by the War Department Oct. 20 to discuss a construction program incident to plans for national defense resulted in the appointment of an executive committee from among those present to call a larger conference of allied interests among civilians to be held probably in January. Those attending the conference represented contractors, engineers, architects, material and equipment men, accountants, attorneys, transportation experts and men familiar with problems affecting labor. Practically all those attending had been connected with the government during the World War.

Secretary Weeks, Quartermaster General Hines and various other officials and army officers addressed the gathering, explaining the present organization which would function for the construction of cantonments and other necessary works in the event of war, and asking suggestions.

General discussion followed. It was the idea of many of those attending that the subject should be treated as a unit and not separated into its segregated parts until a general policy has been developed and a program laid down as a whole.

The executive committee selected to arrange plans for a more general conference of civilians with the War Department at a future date is composed of:

Gen. R. C. Marshall, Jr., general manager, Associated General Contractors, Washington, chairman; Col. A. A. O'Brien, attorney, Washington, secretary; Col. J. H. Alexander, vice-president, Cleveland Railway Co., Cleveland, O.; Francis Blossom, engineer, New York; J. W. Cowper, contractor, Buffalo; Col. Frank M. Gunby, Boston; W. O. Washburn, American Hoist & Derrick Co., St. Paul; J. Sanders Davies, accountant, New York; C. E. Denney, vice-president, New York, Chicago & St. Louis R.R., Cleveland, O.; Leonard Metcalf, Boston; C. A. Morse, chief engineer, Chicago, Rock Island & Pacific R.R., Chicago; Col. William A. Starrett, vice-president, Starrett Bros., contractors, New York; and Col. J. N. Willcutt, L. D. Willcutt & Sons Co., Boston.

A. S. M. I. Will Study Standard Contract of A. G. C.

The standard contract form drafted by the Associated General Contractors of America and other organizations for building and general engineering construction is to be studied by officials of the American Society for Municipal Improvements with a view to the possibility of making necessary alterations and a recommendation that a standard form be adopted for municipal work. It would be necessary to make changes to conform to different laws, and possibly to change the arbitration clause.

U. S. Will Build Terminal on Mississippi at Baton Rouge

So as to provide direct interchange with the Gulf Coast lines the Inland Waterways Corporation will build terminals at Anchorage on the west side of the Mississippi at Baton Rouge.

General T. Q. Ashburn, in charge of the corporation, declares that the benefits of corporate management for the government's barge lines already are being demonstrated in greatly increased efficiency. While the barges for a long time have been offered more cargo at St. Louis for the downstream trip than could be carried, it has been only in recent weeks that upstream offerings at New Orleans have exceeded the capacity of the boats.

The Shipping Board has just transferred four concrete tankers to the Waterways Corporation. Each tanker has a capacity of 40,000 bbl. They will be used by the corporation for the storage of oil. Two of the tankers will be tied up at the New Orleans terminal, one will be sent some point up the river, and another assigned to Mobile.

New York Law Jeopardizes Highway Bridge Safety

Albany Correspondence

Study of New York State bridge laws has just revealed a dangerous condition created by an act of the legislature passed last Spring, which purports to shift the legal responsibility for highway bridge construction and maintenance from the counties to the state. The probable effect of the act is to stop much necessary bridge maintenance and repair work. Apparently the act is the result of efforts continued for nearly ten years to relieve the counties of the burden of caring for highway bridges.

In 1915 a study of bridge conditions, made for the legislature, showed that 30 to 35 million dollars would be required to bring all highway bridges in the state up to 15-tons capacity. A new study, ordered in 1923, covering bridges on state and country highways (5,486 bridges), showed a cost of $19,000,000 for repairs and rebuilding. The legislature thereupon made nominal provision for the bridge improvement suggested by this report, but did not appropriate money to carry out the work.

The new law, amending the previous highway law, provides that after Jan. 1, 1926, all unsafe bridges on state or country highways shall be condemned, repaired and maintained by the state as part of the highway, and that all new bridges required shall also be built and maintained by the state, except that 35 per cent of the cost of new bridges is to be paid by the county. This amendment will make the state legally liable for the damage risks of unsafe bridges, after 1925. In the absence of an appropriation to care for bridges, it is not possible to make the bridges safe, however.

Present expectations are that the next legislature will be asked either to repeal the amendment or to provide funds for repairing, rebuilding and maintaining bridges.

Clifford M. Holland Dies

(*Continued from p. 723*)

tions carried him to the grades of division engineer and tunnel engineer. Among the important New York subway tunnels to which he was assigned for duty were the Battery-Joralemon St. tunnel under the East River, the Fourth Ave. subway in Brooklyn, the Whitehall-Montague St. tunnel, the Willoughby-Montague St. tunnel, the Fulton St. subway, the Old Slip-Clark St. tunnel, the 14th St.-North 7th St. tunnel, and the 60th St. tunnel.

During these years Mr. Holland gained an experience in designing and constructing subaqueous tunnels possessed by few engineers, and when the time came to choose the chief engineer for the Hudson River vehicular tube project he was selected for the post on the strength of his excellent record, in spite of the fact that he was a comparatively young man—then only 36 years old—and that other older and more widely known engineers were being considered for the appointment. Mr. Holland's record was so satisfactory to the two state commissions and the variety of his service so complete that the choice for the vehicular tube work fell on him.

He proceeded with characteristic energy to organize his engineering staff for the new project, surrounding himself with men of proved ability on tunnel design and construction. In fact he made it a condition of his appointment that he be given a free rein in the selection of his engineering personnel. He took enormous pride in his organization and in spite of the ever-increasing weight of his responsibilities, he maintained an almost boyish enthusiasm for his work and for the men of his staff. In connection with his duties as chief of the vehicular tube, Mr. Holland, in 1921, was sent to Europe by the New York-New Jersey Tunnel Commission to inspect foreign methods of design and construction and secure at first hand data to be applied to the Hudson River work.

Insisted on Cast-Iron Rings

The early stages of the vehicle tunnel brought out insistent advocates of several different types of construction for the 29½-ft. tubes, including bolted cast-iron ring lining, concrete blocks and floating caissons sunk to place. Mr. Holland was a staunch believer in the cast-iron ring type and in the face of great pressure for the adoption of other designs he stood his ground and ultimately secured the endorsement of the type of construction which his experience convinced him was best adapted to the work in hand.

Mr. Holland took a keen interest in engineering society affairs and at the time of his death was a director of the American Society of Civil Engineers. He took an active part in opposing the society's entrance into the Federated American Engineering Societies. He was president of the Harvard Engineering Society. On account of Mr. Hollands' sudden death, the celebration of the holing through of the tube planned for Oct. 29, when President Coolidge was to have given the signal for breaking down the barrier between the pair of headings, has been postponed.

Towne Will Aids Engineering and Industrial Research

Both engineering and industrial research are to be given impetus through the will of Henry R. Towne, formerly head of Yale & Towne Manufacturing Co., of Stamford, Conn., whose death was noted in these columns recently. The engineering bequest is made to the Engineering Foundation and amounts to $50,000. Then, a sum estimated in the neighborhood of $2,000,000 with a specific trust fund of $50,000 is provided for the institution and maintenance of museums of the peaceful arts for the people of the city of New York. Income is to be used in a campaign of education "designed to bring prominently to public notice essential facts regarding the great industrial museums of Europe and to create a public understanding of the useful and importance of such an institute." The residuary estate is to form a trust fund known as "The Henry R. Towne Endowment Fund," income from which will be used to erect museum buildings.

The bequest to the United Engineering Society establishes the "Henry R. Towne Engineering Fund," income from which is to be expended by the Engineering Foundation Board for the purpose as stated in its charter—"the furtherance of research in science and in engineering, or for the advancement in any other manner of the profession of engineering and the good of mankind."

Mr. Towne was an engineer and manufacturer, a past-president of the American Society of Mechanical Engineers, and a close friend of Ambrose Swasey, whose original bequest established the Foundation in 1914.

Charles F. Rand, chairman of the Foundation Board, has announced the appointment of 190 leading engineers in 27 cities as local representatives of the Foundation to aid carrying on nation-wide research. All of the appointees have accepted. They represent 41 national and local engineering societies.

Philadelphia Considering Street Cleaning, Engineering Bureaus

Ordinances providing for bureaus of engineering and street cleaning, both to be under the Department of Public Works, have been introduced in the city council of Philadelphia. The Bureau of Engineering would take over work now handled principally by the Survey Bureau of the Department of Public Works. It would have charge of the design and construction and operation of sewers and sewage-works, the design and construction of bridges, and the abolition of grade crossings, together with such special work as might be required. Its personnel would consist of a chief engineer, assistant engineer, division engineer, and heads of divisions. If the bureau is established, it is thought that John A. Vogelson, now chief of the bureau of surveys, will be made chief engineer. The proposed Bureau of Street Cleaning would handle the cleaning work now under the supervision of the Bureau of Highways.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, San Francisco, Calif., Nov. 17-20, 1924.

ADVISORY BOARD ON HIGHWAY RESEARCH, Washington, D. C.; Annual Meeting, Washington, Dec. 4, 5.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 5-9, 1925.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 27-29, 1925.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 24-27, 1925.

The National Rivers and Harbors Congress will hold its twentieth convention in Washington, D. C. Dec. 10 and 11. Subjects to be discussed include agricultural relief through development of inland waterways, free ports, further strengthening of the long and short-haul clause, a navigable connection between the Great Lakes and tidewater, rate differentials, and through route and joint rate arrangements between railways and waterways.

Personal Notes

ERNEST BOYCE, formerly assistant engineer, has been appointed chief engineer of the Missouri State Board of Health, director of water and sewage laboratories and associate professor of sanitary engineering at the University of Kansas. He fills the vacancy resulting from the resignation of ALBERT H. JEWELL, former chief engineer of the State Board of Health, who has become executive secretary of the Health Conservation Association of Kansas City, Mo.

ISAAC VAN TRUMP, director, and ALBERT C. GALT, manager of the southern branch of the Van Trump Testing Laboratory, announce the occupation of new offices in Little Rock, Ark., in the Gazette Building.

J. L. KILPATRICK, Glen Ridge, N. J., has been promoted to the office of assistant vice-president of the Western Electric Co., and W. T. TEAGUE, East Orange, N. J., has been appointed general manager of installation, the post previously held by Mr. Kilpatrick. Mr. Kilpatrick formerly was engineer of buildings and equipment for the Bell Telephone Co. of Pennsylvania.

JOHN L. WEBER, Trenton, N. J., hydraulic engineer with the New Jersey State Department of Conservation and Development, has resigned and opened an office as civil and hydraulic engineer at 224 E. Hanover St., Trenton.

COL. WILLIAM D. WRIGHTSON, sanitary engineer, U. S. Public Health Service, has succeeded a physician as health officer of Quincy, Ill. Colonel Wrightson has had a wide experience in sanitation and public health work with the Public Health Service, U. S. Army, International Health Board and foreign governments. Colonel Wrightson is a graduate of the University of Maryland. Until 1910, when he first entered sanitary engineering work (as an assistant to General Gorgas in the Panama Canal Zone) he engaged in both railroad and mining engineering work. After two and one-half years on the Panama Canal he was made chief engineer of the Texas Co. at Houston, Texas, and in 1913 became engineer for the Pasadena Petroleum Co., Shreveport, La. Colonel Wrightson then spent some months as sanitary engineer for the expeditionary forces of the U. S. Army in Vera Cruz, Mex. Early in the United States' participation in the World War he was placed in charge of the Sanitary Corps of the National Army.

FREDERICK A. SMITH, Chicago, has entered private practice as consulting engineer in municipal, hydraulic and railway work, with office at 208 N. Wells St., Chicago. Mr. Smith was for several years an assistant engineer in the city's Department of Public Works and was previously in railway service.

CHARLES E. WELLS has been appointed city engineer of North Adams, Mass., succeeding WILLIAM I. BAUCUS who recently resigned to become city engineer of Northampton, Mass.

JOSEPH S. ARBUCKLE is to be district manager in charge of the new Tulsa, Okla., office of the Edwin Burhorn Co., engineers, contractors and manufacturers, 25 Broadway, New York City, manufacturers of cooling towers, steel plate construction and castings.

E. W. POTTER, president of the British Engineers' Association, is visiting Canada. When interviewed in Montreal, he stated that an agitation has been in progress for some time to standardize courses in engineering education in schools and colleges throughout the British Empire and that degrees would soon be of equal value whether granted by British colleges or those of Canada or the other Dominions.

JESSE A. JACKSON, who has been superintendent of parks in the city of Seattle for three years, has resigned to enter private practice as consulting engineer, specializing in city planning, residential subdivisions and landscaping, with offices in the Lyon Bldg., Seattle. Prior to his work with the park department, Mr. Jackson was in the city's engineering department for twenty years.

F. H. COTHRAN, vice-president of the Quebec Development Co., Ltd., and vice-president and general manager of the Alma & Jonquiere Ry., has been elected vice-president of the Duke-Price Power Co., Ltd., with headquarters at Isle Maligne, Que.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Building Material Exports Show Increase

Chamber of Commerce Figures Given for Lumber, Pipe, Steel, Cement and Other Products

NOTEWORTHY increases in the export of building and construction materials from the United States during the first half of the present year are revealed in a bulletin issued by the Foreign Commerce Department of the Chamber of Commerce of the United States, giving the results of an analysis of foreign trade for that period.

During the January-June period of this year we shipped abroad, chiefly to Japan, China, Cuba, Mexico, Great Britain, and Canada, 976,607,000 ft. b.m. of lumber (boards, planks and scantlings) valued at $41,708,000, while during the same period of 1923 there were exported 862,151,000 ft., valued at $40,409,000, an increase of 13 per cent in quantity and 3 per cent in value for the first half of 1924. Exports of logs and timber made a noteworthy increase in value, from $10,454,000 to $17,116,000, or 64 per cent, and a gain in quantity shipped abroad from 291,779,000 to 524,030,000 ft. b.m., or 80 per cent above the 1923 figures.

Gain in Pipe

Pipes and pipe fittings also helped to swell both the value and quantity of our increase in exports. During the first half of 1923 these exports amounted to 233,031,000 lb., valued at $12,164,000; for the first half of 1924 we exported 301,122,000 lb., valued at $16,199,000, a gain in value of 33 per cent and in quantity of 29 per cent. A 5 per cent increase in value of structural iron and steel, from $6,658,000 to $6,973,000, can be attributed to higher prices for this construction material, as the volume declined 17 per cent, from 223,288,000 to 189,981,000 lb. On the other hand, the exports of paints, pigments, and varnishes, although falling 6 per cent in value, from $7,944,000 to $7,500,000, increased in quantity 3 per cent, from 68,233,000 to 70,421,000 lb.

Exports of paper boards increased in quantity from 26,549,000 to 36,949,000 lb., or 39 per cent; but hydraulic cement declined 8 per cent, from 198,551,000 to 183,687,000 lb. Iron and steel bars and rods decreased in volume shipped, from 246,891,000 to 168,957,000 lb., or 32 per cent; and rails from 53,368,000 to 45,146,000 lb., or 15 per cent.

Figures for Imports

Few building materials are found among imports valued at more than $5,000,000. Imports of lumber (including boards, planks, deals, and sawed cabinet woods) declined in value from $30,164,000 to $24,989,000 and in quantity from 980,390,000 to 816,347,000 ft. b.m. —a loss of 17 per cent in value and volume. Lath imports sustained a slight loss in quantity, from 784,195 to 779,995 thousand, or 0.5 per cent. Shingles were off 12 per cent in volume having declined from 1,322,000 to 1,159,000 thousand. Imports of glass decreased from $10,746,000 to $10,332,000 in value, or 4 per cent, with plate glass imports off 8 per cent, from 12,486,000 to 11,490,000 sq.ft. Imports of hydraulic cement show a gain of 126 per cent in quantity, from 163,813,000 to 369,752,000 lb. The value of imports of cement for the first half of 1924 was $1,468,000.

Another construction material making a noteworthy increase is pipes and pipe fittings. A gain for this item of 990 per cent is recorded in volume imported, or from 5,957,000 to 64,918,000 lb.; the 1924 value of these imports is $1,402,000. Paper board imports show a gain of 15 per cent, or from 54,154,000 to 62,013,000 lb.; the value for the first half of 1924 is $1,663,000.

Number of Road Show Exhibitors Now Exceeds 200

Applications for exhibit space at the Road Show, to be held in the Coliseum, Chicago, Jan. 5-9, include more than 200 manufacturers of road-building equipment and materials. This is a greater number than had applied at this time last year or in previous years, and by the time the allotment of space is made Nov. 10 it is expected that the previous record for the total number of exhibitors will have been passed. The increased space, in addition to making it possible to accommodate a greater number of exhibitors, will offer an opportunity for larger and more attractive exhibitions than have been possible in the last few years.

Paving Season Running Late, Brick Shipments Show

Continued activity in the paving brick industry for September on a scale only slightly under that of August indicates that the late start in street and road work during the spring is being made up by continuing operations on a larger scale than is usual this fall. September shipments of 31,563,000 brick were less than a million lighter than in August. Unfilled orders have been reduced on the books from 76,867,000 in August to 74,089,000 in September.

Stock on hand was reduced from 97,407,000 to 86,875,000. A total of 25,833,000 paving brick were manufactured during September as compared with 26,569,000 for August. Twenty-two companies, representing 61 per cent of the tonnage of the industry reported their plants working at 88 per cent of capacity.

Architectural Terra Cotta

Bookings of architectural terra cotta by 26 manufacturers, who produced about 95 per cent of the architectural terra cotta made in 1922, have been reported to the Department of Commerce for the first seven months of 1924 and are shown below in tonnage and in value. Values exclude freight, cartage, duty and setting charges.

BOOKINGS OF ARCHITECTURAL TERRA COTTA

	Net Tons	Value
January	16,240	$1,561,[illegible]
February	13,227	1,467,[illegible]
March	12,022	1,316,[illegible]
April	13,011	1,570,[illegible]
May	10,171	1,229,[illegible]
June	10,807	1,127,[illegible]
July	10,831	1,475,[illegible]

Concrete Blocks, Bricks and Tiles Standardized in Size

Extensive simplifications of concrete blocks, concrete building tile and concrete bricks were adopted Oct. 16 at a conference of manufacturers, distributors and users of concrete products, held in Chicago under the auspices of the Division of Simplified Practice, Department of Commerce. The standard sizes shown in the tabulation herewith replace concrete block formerly made in 30 different lengths, 20 widths and 26 heights; concrete brick, both face and common, formerly made in 6 lengths, 7 widths and 6 heights; and concrete building tile, formerly made in 8 lengths, 7 widths, and 5 heights.

For concrete block the permissible variations approved were ⅛ in. under

APPROVED STANDARD SIZES

	Height In.	Length In.	Width In.
Conc. block....	7⅝	15⅝	6, 8, 10, 12
Conc. brick....	2¼	8	3⅝
Conc. bld'g tile			
(1) Load bearing	5	12	3⅝, 8, 12
(2) Partition...	3, 4, 6, 8, 10, 12	12	12

in height and length and ¼ in. in width; and for building tile 3 per cent, over or under, in height, width or length.

The meeting was presided over by Ray M. Hudson, chief of the Division of Simplified Practice, who was assisted by H. Ross Colwell of the Division.

Attendance

The attendance included Leslie H. Allen, general manager, Concrete Tile Mchy. Co., Cicero, Ill.; W. D. M. Allan, secretary of the Illinois Concrete Products Assoc'n, Chicago; R. H. Barriball, Cleveland Mfg. Co.; C. L. Bourne, Portland Cement Assoc'n, Chicago; Harry W. Conway, secretary, Cleveland Concrete Products Assoc'n; A. J. R. Curtis, Portland Cement Assoc'n, Chicago; E. W. Dienhart, Acme Concrete Products & Gravel Co., Cement City, Mich.; C. B. Dutton, Besser Sales Co., Chicago; C. H. Goslin, Detroit Concrete Assoc'n, Detroit, Mich.; Wallace R. Harris, Concrete Products Assoc'n, Chicago; A. E. Lindau, president, American Concrete Institute, Chicago; H. E. Hopkins, "Cement Mill and Quarry," Chicago; J. W. Lowell, Universal Portland Cement Co., Chicago; Eugene Olson, Anchor Concrete Mchy. Co., Columbus, O.; F. A. Owen, Akron Concrete Products Assoc'n, H.

E. Smith, "Concrete Products," Chicago; A. G. Swanson, secretary, Omaha Concrete Stone Co.; and S. H. Wightman of Besser Sales Co., Chicago.

The recommendations for simplification as indorsed are being sent to the entire industry for formal acceptance, as a preliminary to the publication by the Division of Simplified Practice of the standards in its "Elimination of Waste" series.

Business Notes

THOMAS ELEVATOR CO., Chicago, on Oct. 16 purchased the major part of the goods, merchandise, machinery, equipment and personal property of Louis Falzer & Co. The terms involved the payment of $6,400 in cash on Oct. 16, 1924, and $5,100 to be paid in cash Oct. 26, 1924.

AUSTIN MACHINERY CORP., which recently moved its general offices from Toledo, Ohio, to Muskegon, Mich., announces the officer personnel of the organization as follows: O. A. Seyferth, vice-president and general manager; N. D. Farmer, treasurer; Charles Bradrick, secretary; G. S. Pierson, sales manager; George T. Rosselle, general superintendent; V. G. Halby, chief engineer; G. T. Stuart, advertising manager.

MICHAEL H. CONNELLY has been appointed manager of sales of the General Steel Casting & Machine Co., Inc., Albany Car Wheel Co. and Reading Car Wheel Co., with offices at 8 Lister Ave., Newark, N. J.

DRAVO EQUIPMENT CO., Cleveland, has been appointed distributor in eastern Ohio, for caterpillar tractors made by the Holt Manufacturing Co.

BEN F. DUPUY, recently resigned as city engineer of Glendale, Calif., has been appointed sales manager of Besone's Distributing Co., Los Angeles, a company engaged in hauling and spreading road oil.

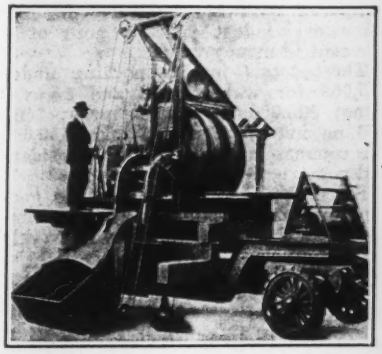
FRANK BARR KNIGHT, engineer and manager of the Chicago branch of the Lidgerwood Manufacturing Co., died suddenly of heart failure Oct. 12 at his residence in Highland Park, Ill. He was born in Worcester, Mass., Feb. 13, 1872. He was graduated from Worcester Polytechnic Institute in 1892 and entered the employ of the Lidgerwood Manufacturing Co., his sole employer from 1892 until his death. He first entered the cableway department as a draftsman and later was trained as a cableway erector. Mr. Knight's work brought him in contact with every phase of cableway design, construction, and operation. He made several improvements in cableways, notably excavating buckets and aerial dumping appliances. From 1894 to 1896 he was in charge of field construction on the Chicago Drainage Canal where many Lidgerwood cableways were employed. In 1908 Mr. Knight was made manager of the Chicago branch of the Lidgerwood company.

Equipment and Materials

Drop-Down Power Loader for Mixer on Trailer

In concreting lamp-post bases time is often lost in moving the mixer from one set-up to the next and getting ready to pour, but the Electric Contracting Co., of Chicago, has cut this lost time down to a small item by mounting on a trailer a 14-S Marsh-Capron mixer with a special drop-down power loader. The mixer is ready for action as soon as the trailer stops and can move on at once as soon as the pour is complete. It travels at motor truck speed.

In order to be able to discharge concrete directly into dump bodies mounted

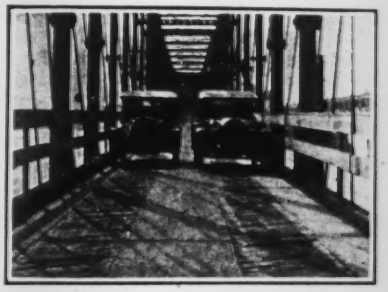


on Ford trucks, the mixer was blocked up on the trailer, but, as the photo shows, the drop-down power loader is filled directly from wheelbarrows on the ground. Except for the special mounting and drop-down power loader, the mixer is a standard machine with rail tracks for the main drum bearings, turning on mine-car-wheel rollers.

Steel Traffic Treads for Wooden Floors of Bridges

To prevent wear on plank floors of bridges the Alan Wood Iron & Steel Co., Philadelphia, manufactures traffic treads in the form of rolled steel strips with diamond-shaped studding anchored to the roadway by square-head lag screws. In addition to saving re-planking costs the steel traffic treads, it is claimed, reduce vibration and prevent the working up of nails and spikes from the floor, causing punctures in pneumatic tires of vehicles.

For practically all forms of traffic

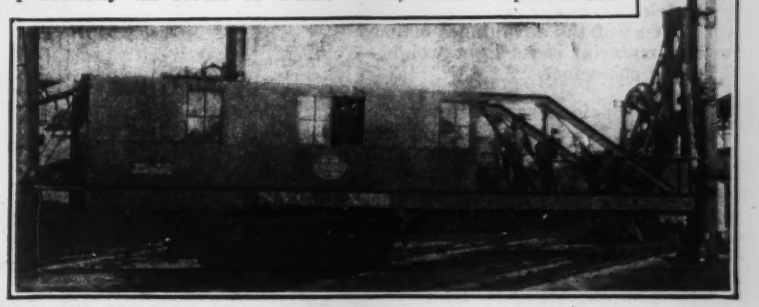


the manufacturer recommends the use of $\frac{5}{16}$-in. steel treads, although in the case of abnormally heavy traffic $\frac{1}{4}$-in. treads should be considered. The length of the treads is from 15 to 20 ft. each. Width depends on the width of the bridge and conditions of traffic. For two-line traffic, such as is shown in the accompanying photograph, the side treads are often 18 to 24 in. wide and the center line treads from 30 to 42 in. wide. The weight of the $\frac{5}{16}$-in. treads is 8.7 lb. per square foot and of the $\frac{1}{4}$-in. treads 11.5 lb. per square foot. Ordinarily holes in the treads to receive the lag screws are punched in the shop prior to shipment.

R.R. Piledriver Has Long Reach and Full Circle Swing

Designed with a long reach of 33 ft. 9 in. at right angles to the track and a full circle swing, the large piledriver shown in the illustration herewith was built for the New York Central R.R. by the McMyler-Interstate Co., of Bedford, Ohio. The machine weighs 15 tons, is mounted on a pair of four-wheel railroad trucks, and is operated by horizontal steam engines with 13x12-in. cylinders served by a 60-in. locomotive type boiler. The full circle design, the manufacturer points out, permits direct leads for all operating cables and avoids numerous reversing bends with consequent wear and strain on the cables. The long reach of the machine makes it possible to span an adjacent track and drive far side abutment piles, at the same time leaving an open right-of-way.

The machine is equipped with a Vulcan-Warrington No. 2 steam hammer fitted with a McDermid base. Double hoisting drums furnish direct leads to both hammer and pile lines, while a separate set



of drums actuates the mechanism for raising and lowering the leads. From a position for vertical driving the leads can be turned and fixed at any angle within 15 deg. of the vertical for driving batter piles. In the propelling mechanism there is a gear shift giving two traveling speeds of 7½ and 20½ miles per hour respectively.

Publications from the Construction Industry

Alloy Steels—CENTRAL STEEL CO., Massillon, Ohio, has just issued a 48-p. illustrated booklet describing the manufacture and applications of its Agathon alloy steels, which are supplied in ingots, billets, bars, sheets, and strips. The chief alloys used are nickel, chromium, vanadium and molybdenum. A considerable portion of the booklet is given over to charts showing the physical properties of different alloy steels, accompanied by an explanation of the uses to which they are best suited. These include gears, axles, drive shafts, crank and cam shafts, springs, shackle bolts, piston rods, and other machine parts. Tables show the chemical composition of the various alloy steel and their weights.

Pumping Data—ALDRICH PUMP CO., Allentown, Pa., has issued a 22-p. pamphlet of engineering data related to pumps and pumping. There are tables of conversion equivalents for length, area, volume, pressure, energy, and mass. Also tabulations giving the capacity of reciprocating pumps, friction losses in straight pipe and elbows, discharge nozzles, transmitting efficiency of shafting at various speeds, and pipe dimensions and weights.

Rock Asphalt—KENTUCKY ROCK ASPHALT CO., Louisville, in a 15-p. illustrated pamphlet describes and illustrates the use of Kyrock for railroad construction and maintenance. Illustrations are shown of its application to grade crossings, platform runways and shop floors. An insert contains standard specifications for Kentucky rock asphalt surface for railway use.

Gypsum Roofing—UNITED STATES GYPSUM CO., Chicago, has issued a 16-p. illustrated pamphlet on Sheetrock-Pyrofill construction for roofs and floors. This is a poured-in-place construction, in which the composition board constitutes the forms; reinforcement of the poured gypsum is provided by electrically welded galvanized steel fabric. One of the advantages claimed for this material is its light weight—56 lb. per cubic foot.

Steam Shovels—THEW SHOVEL CO., Lorain, Ohio, has issued a new bulletin on its ¾-yd. revolving shovel, Type O. There are 12 pp. of text and illustrations showing details of the principal parts of the machine, including engine, boiler, turntable, boom, stick and dipper. A table of working ranges and capacity is given for both 18-ft. and 14-ft. dipper sticks.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Construction Heavier Than Year Ago

Contract Values, Physical Volume And Building Permits Point To 1924 As Record Year

Judging the construction situation by contract values, actual physical volume and building permits issued, the close of the third quarter found the industry considerably ahead of the corresponding period last year.

Contracts awarded on large engineering construction projects, as published in *Engineering News-Record*, totaled $1,535,137,000 for the entire U. S., from Jan. 1 to Oct. 1, 1924. This is compared with $1,469,349,000 for the same period last year—a gain of 4 per cent in money value.

These totals involve nothing under $15,000 for water-works and excavations; $25,000 on public works; $40,000 on industrial plants and $150,000 for commercial buildings. No residential construction is included.

Since the first of October, the general upward trend has been maintained as shown by the following weekly records of contracts let:

Week of	Public Work	Private Work	Total Contracts
Oct. 2.....	$14,140,000	$14,765,000	$28,905,000
Oct. 9.....	15,048,000	49,481,000	64,529,000
Oct. 16.....	13,291,000	17,012,000	30,303,000
Oct. 23.....	18,762,000	30,127,000	48,889,000
Total four weeks...	$61,241,000	$111,385,000	$172,626,000

From the standpoint of actual physical volume, the amount of construction work accomplished during the first four weeks of October was 12 per cent greater than that of the preceding month and 19 per cent heavier than October, 1923. This of course is taking the year 1913 as 100 and considering construction volume as the amount of work that could be done with 1924 money and 1913 prices.

There has been a consistent downward trend in prices of most of the basic construction materials since May, 1924. Exceptions, however, are

Continued on p. 731)

Commercial Building Contracts Gain In Number and Value

Contracts awarded on large commercial buildings throughout the United States during the first nine months of this year at a minimum value of $150,000, numbered 1,993 against 1,658 for the same period last year. The average values of the contracts for these two periods are $378,000 and $336,000, respectively.

The total value of large building contracts for the present year to date is $785,737,000 compared with $727,124,000 for the corresponding period last year. This gives 1924 a lead of $58,613,000 in this one class of construction.

The accompanying tables show the types and number of buildings included and the money value of average contracts for each type.

CLASSIFICATION OF COMMERCIAL BUILDING CONTRACTS ACCORDING TO USE, NUMBER AND VALUE FOR FIRST NINE MONTHS OF 1924

(000 omitted)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total	Per Cent of Total
Hotels and Apartments....	$19,405	$36,971	$28,428	$15,756	$38,870	$16,801	$15,998	$22,541	$31,139	$225,909	30 2
Schools.....	12,728	16,259	16,059	19,707	18,067	11,135	19,326	15,724	13,762	142,767	19 0
Offices.....	19,785	16,654	11,145	8,300	9,876	9,847	15,353	14,506	5,825	111,291	14 6
Hospitals.....	3,215	16,537	3,230	11,439	12,282	1,470	1,209	3,117	4,379	42,878	5 8
Stores.....	6,905	4,880	1,850	4,912	6,813	3,157	3,202	3,760	1,800	37,079	5 1
Warehouses.....	3,033	3,210	3,619	1,627	5,632	1,300	2,500	1,770	775	23,466	3 1
Theatres.....	450	1,585	2,300	2,675	9,000	1,070	1,900	1,054	570	20,604	2 8
Churches.....	2,479	3,217	3,402	1,752	4,000	5,600	3,725	5,358	2,671	32,204	4 2
Clubs, Lodges, Halls.....	1,862	1,581	3,294	3,713	3,586	5,180	2,251	5,017	6,936	33,419	4 4
Public.....	3,810	654	3,797	1,679	2,725	7,755	11,333	2,918	12,239	46,910	6 2
Garages.....	3,580	3,375	1,550	610	1,395	1,930	1,750	650	3,500	18,340	2 4
Banks.....	2,427	1,079	1,860	1,633	1,310	1,500	1,035	400	.....	11,244	1 5
Exchanges.....	1,335	.....	1,000	575	1,165	950	1,700	218	399	7,342	1
Total.....	$81,014	$105,802	$81,534	$74,378	$114,720	$67,695	$81,282	$77,033	$83,995	$753,453	100
Number.....	266	229	218	225	249	183	223	210	190	1,993	
Average contract	$359	$458	$374	$330	$458	$348	$365	$367	$442	$378	

NUMBER OF COMMERCIAL BUILDING CONTRACTS LET FOR VARIOUS TYPES DURING FIRST NINE MONTHS OF 1924

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total	Average Contract
Hotels and Apartments....	85	51	71	56	56	35	40	46	41	481	$470,000
Schools.....	40	51	51	64	67	42	65	50	62	492	290,000
Offices.....	22	20	20	17	20	16	24	24	17	180	618,000
Hospitals.....	12	12	8	19	14	8	6	12	15	106	404,000
Stores.....	14	16	10	16	16	12	14	12	2	112	331,000
Warehouses.....	22	13	8	3	15	6	9	10	4	90	260,000
Theatres.....	3	3	4	7	5	5	9	6	4	46	448,000
Churches.....	15	15	15	10	17	16	18	22	12	140	230,000
Clubs, Lodges, Halls.....	6	5	9	13	14	12	11	12	12	94	355,000
Public.....	12	2	6	5	9	13	11	11	8	77	601,000
Garages.....	19	36	6	4	6	11	5	3	11	101	181,000
Banks.....	11	5	8	8	6	5	6	1	0	50	275,000
Exchanges.....	5	..	2	3	4	2	5	1	2	24	306,000
Total.....	266	229	218	225	249	183	223	210	190	1,993	$378,000

Construction Heavier Than Year Ago

(*Concluded from p. 730*)

offered in the form of rising tendencies in certain materials, such as: clay products, paint stuffs, lime, red cedar shingles and yellow pine flooring.

General costs, however, are 0.4 per cent below the levels prevailing Oct. 1 and 6 per cent under those in effect at this time last year.

With the cost trend downward and that of construction volume upward, demand for more construction and the availability of men and materials are the next steps to consider.

There are about half enough skilled building trades mechanics, particularly bricklayers, plasterers, plumbers and carpenters. No immediate reduction in wage schedules can, therefore, be expected and possibilities are always present of advances being demanded.

Materials are plentiful, however, and no abrupt rise in prices is anticipated. There are at present more burned brick on hand at yards and a greater quantity of cement stored at mills throughout the country, than a year ago. The lumber cut is also in excess of shipments, leaving a moderate reserve available. Iron and steel stocks are not exhausted, especially in the warehouses.

The increased number of large jobs on which bids are being asked, as published weekly in the Construction News section of *Engineering News-Record*, shows the gain to be principally in private projects and large commercial buildings.

Viewed from the standpoint of building permits, a survey prepared by S. W. Straus & Co., shows the situation to be as follows:

"The volume of building permits issued and plans filed throughout the country during the first nine months of the present year was between six and seven per cent ahead of the corresponding period in 1923. This is indicated by the complete official reports from the 320 leading cities and towns which showed $2,778,740,612 compared with $2,601,816,803, a gain for the nine months period of $176,923,809.

"The Eastern and Southern sections of the country made praiseworthy gains during the three-quarters period. In the East a 16 per cent increase was shown while the 49 leading cities of the South made an aggregate increase of 13 per cent. The Central and Far Western sections of the country displayed slight losses.

"Among the large cities, New York made a new high record during the three-quarters of the year, the total in plans filed for the period being $681,693,000, compared with $575,015,000 last year, a gain of $106,678,000 or nearly 20 per cent. Detroit, Philadelphia, Boston, San Francisco, Milwaukee, Baltimore, Dallas, Denver, Providence, Louisville and Rochester made gains worthy of notice.

"The showing in September was slightly better than for the nine months period. Every section of the country revealed greater potential activities. The Southern cities gained 20 per cent; Eastern, 12 per cent; Western, 4 per cent, and Central 2 per cent.

"The twenty-five leading cities of the country gained about $12,000,000 over September, 1923, and $17,000,000 over September, 1922.

"The reports indicate that in both New York and Chicago the gain in building activities has been somewhat checked. Plans filed in New York were $45,748,315 as against $44,104,374 in September, 1923, and $49,628,756 in September, 1922. Chicago reported the issuance of building permits amounting to $22,228,200 as compared with $27,874,705 in September last year, and $12,263,100 in September, 1922.

"An interesting feature of the month's report was the return of Los Angeles to third place among the cities of the country, although it ranked fourth for the nine months period.

"Detroit continued to show tremendous building activities, the amount of permits issued being $12,542,789, compared with $9,708,726 in September, 1923. Large gains for the month also were made in Cleveland, Boston, San Francisco, Washington and Milwaukee.

CONTRACTS AWARDED ON LARGE ENGINEERING CONSTRUCTION PROJECTS FOR THE ENTIRE U. S.—JAN. 1 TO OCT. 1, 1923

	New England (000)	Middle Atlantic (000)	South (000)	Middle West (000)	West of Mississippi (000)	Far West (000)	Total U. S. (000)
January	$10,797	$37,648	$10,146	$42,329	$25,391	$11,367	$137,678
February	3,545	32,433	11,481	37,359	21,450	16,096	122,364
March	10,844	52,520	15,734	51,373	50,648	20,676	201,795
April	13,627	58,149	17,936	39,941	36,385	20,735	186,773
May	16,059	50,418	23,813	45,360	25,589	30,793	192,032
June	10,193	43,357	15,373	58,783	29,945	20,936	178,587
July	8,897	34,633	24,065	42,044	25,666	19,718	155,023
August	4,308	30,933	11,974	34,425	24,962	21,555	128,157
September	6,585	40,893	20,757	39,116	32,055	27,534	166,940
Total nine months	$84,855	$380,984	$151,279	$390,730	$272,091	$189,410	$1,469,349

CONTRACTS AWARDED ON LARGE ENGINEERING CONSTRUCTION PROJECTS FOR THE ENTIRE U. S.—JAN. 1 TO OCT. 1, 1924

	New England (000)	Middle Atlantic (000)	South (000)	Middle West (000)	West of Mississippi (000)	Far West (000)	Total U. S. (000)
January	$21,667	$42,285	$18,267	$27,979	$21,273	$22,482	$153,953
February	4,886	61,400	19,340	17,162	21,290	25,884	149,962
March	9,503	52,608	18,973	38,103	28,817	18,231	166,235
April	5,769	46,203	20,614	40,501	24,504	25,978	163,569
May	9,358	71,505	27,650	54,498	48,761	31,962	243,734
June	10,095	44,983	12,779	31,947	24,205	22,992	147,001
July	15,296	70,646	27,811	50,847	22,747	11,932	199,279
August	15,231	25,636	15,789	40,611	34,320	26,798	158,385
September	20,375	34,110	13,874	35,009	31,951	17,700	153,019
Total nine months	$112,180	$449,376	$175,097	$336,657	$257,868	$203,959	$1,535,137

Germany Heaviest Exporter of Brick to U. S.

Over 21 Million Have Entered Port of New York From Six Foreign Nations Since July, 1923

Over eighty-one million brick have been shipped into this country through the port of New York from foreign countries since July, 1923, according to figures received by *Engineering News-Record* from the U. S. Department of Commerce.

The six countries supplying this material are: Germany, Holland, Belgium, Canada, Italy and England. The following table shows the quantities received from each, during the thirteen-months period:

Germany	34,912,000
Holland	25,685,000
Belgium	18,709,000
Canada	1,306,000
Italy	580,000
England	45,000
Total	81,237,000

The first four have been shipping steadily since the latter half of 1923. England entered the market in March of the current year and Italy sent her first consignment in June, 1924.

Brick are on the tariff free list under materials not specially provided for, but with this stipulation, that if any foreign country imposes duties on brick from the United States, equal duties are to be levied upon imports into the United States.

The following table shows the brick importations by months from July, 1923, to August, 1924:

Month	Country of importation	Number	Value
1923	Brick, not specially provided for		
July	Holland	9,443,000	$74,377
August	Canada	100,000	1,380
	Holland	3,373,000	26,989
	Germany	63,000	411
September	Holland	5,549,000	48,420
	Canada	425,000	3,925
October	Holland	1,000	10
November	Belgium	2,613,000	14,925
	Holland	2,815,000	22,520
December	Holland	1,000	8
	Sand Lime Brick		
1924			
March	Germany	208,000	1,144
April	Germany	9,469,000	55,020
May	Belgium	133,000	731
	Germany	3,879,000	18,654
June	Germany	1,041,000	6,299
July	Germany	2,282,000	13,380
August	Germany	4,706,000	28,077
	All Other Brick		
1924			
January	Germany	803,000	4,701
	Holland	1,000	10
February	Belgium	2,603,000	17,583
	Germany	187,000	1,030
	Belgium	2,338,000	8,536
March	Germany	9,284,000	55,009
	England	2,000	102
	Belgium	1,612,000	6,845
April	Germany	2,045,000	12,434
	England	20,000	520
	Belgium	2,471,000	18,984
May	Holland	2,700,000	17,812
	England	20,000	526
	Belgium	1,985,000	13,802
June	Germany	500,000	3,000
	Italy	59,000	323
	England	3,000	147
	Belgium	2,504,800	24,237
July	Italy	242,000	1,260
	Holland	110,000	1,100
	Canada	781,000	7,810
	Belgium	2,450,000	17,721
August	Germany	445,000	2,714
	Italy	279,000	1,796
	Holland	1,692,000	15,455
Total		81,237,000	$549,727

The steel erectors strike in New York which began May 1 and still continues

to affect the building industry in this city, together with the heavy importation of brick are responsible for the recent drop in prices.

Common brick were $23.65 per M., delivered at site of job in Manhattan on July 1. By Aug. 1 the price had dropped to $20 and the first week in September found quotations at $17 per M., delivered.

Since then, however, the excess of brick has diminished somewhat, due mostly to early closing of yards in this district. The price accordingly has advanced to the present level of $18@$19 per M., delivered.

The total value of brick imports for this period was $549,727, or an average of about $6.79 per thousand at the New York dock.

Business Briefs

Call money ranged from 2 to 3 per cent, Oct. 27.

Time loans; short terms, 2½@3 per cent; longer periods, 3¼@3½ per cent.

Commercial paper; best names, 3@3¼ per cent; other names, 3½ per cent.

Foreign exchange (Demand):

	Normal	This Week	Last Week	Year Ago
Sterling	$4.8665	$4.50	$4.48⅞	$4.48.1/4
Franc	0.193	0.0521	0.0522	0.0584
Lira	0.193	0.0431	0.0435½	0.0448⅛

Bids Wanted on Big Jobs

Among the projects in Construction News, pp. 237 to 248, on which bids are either asked or will soon be called are the following:

Office, Oakland, Calif., by Central National Bank, $1,500,000.

Hotel, Easton, Pa., Easton Hotel Corp., $1,000,000.

Waterworks for the city of Asuncion, Paraguay. A public official has informed the American Consulate that he is interested in receiving propositions from American engineering and construction companies for the installation of waterworks and sewers.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of October 2, the next, on November 6.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$4.00	$3.00	$3.35	$3.50
Structural rivets, 100 lb.	3.75	4.35	4.75	3.50	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.30	3.38	3.00	3.25	3.87½	3.35	3.25	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	44%	54.2%	43%	53%	55.05%	36%	43.1@54.4%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	56.60@57.60	54.00	57.00	56.20@57.20	55.50	68.00	56.00	65.00	65.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.90	1.80
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.75	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	2.75	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.75	1.75	3.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	55.00	35.00	57.20	55.00	37.75	34.75	+31 00	26.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	23.00	24.00	—22.00	24.00	21.00
Lime common, lump, per bbl.	2.50@3.00	1.45	1.85	1.50	—1.35	2.70	—1.60	2.80	10.50
Common brick, delivered, 1,000	18@19	11.00	11.90	12.00	14.00	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.1004	.0941	.089	.07	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.1004	.0941	.089	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal.	1.08	+1.14	1.20	1.05	1.13	1.23	1.12	1.12	1.13
Common Labor:									
Common labor, union, hour	.75	.30	.....	.82½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.25	—.40 @.60	.75	.50@.55	.35@.50	.50	.62½	25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.60 for Kelly Island and Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.03). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $37.83.

Conditions Affecting the Market

Advances have exceeded declines in the general commodities' markets during the past four months. For the same period *Engineering News-Record* Construction Cost Index Number has shown a consistent downward trend.

In the meantime, however, some sporadic price rises have occurred in such materials as: brick, tile, lime, linseed oil, red and white lead, turpentine, red cedar shingles and yellow pine flooring.

Reports received during the week indicate that lime prices, in the Minneapolis and San Francisco districts, have shown a tendency to slump back to levels prevailing during August. Fir timbers in the San Francisco market advanced $2 per M ft. at the same time.

Reduction of freight rates on cement has been approved by the Public Service Commission at Albany, N. Y., effective Nov. 21, 1924. This will cover common, hydraulic, natural or portland cement in carload lots, minimum weight 50,000 lb., from Hudson to Pine City on the Erie. The reduction will amount to about 9½c. per 100 lb.

The pig-iron market is firm at present levels; inquiries, however, are falling off as election approaches. Steel prices continue on the downward course pursued since last March. Reinforcing bars are still $2 and plates, $1.60@$1.90 per 100 lb. at Pittsburgh mills. Structural shapes are quoted at $1.80@$2, against $1.90@$2, one month ago and $2.50 per 100 lb. last year at this time. Railroads throughout the country have ordered steel rails, spikes, bolts and tie plates valued at more than $3,000,000, during the past week. The non-ferrous metals are all firmer and in better demand.